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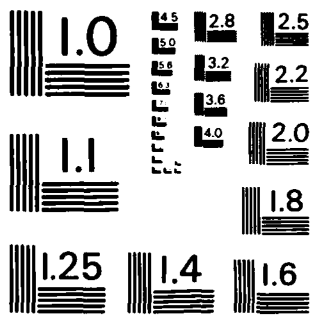

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INTERFACE CONTROL DOCUMENT
FOR
FLIR MISSION PAYLOAD SUBSYSTEM
OF
U.S. ARMY REMOTELY PILOTED VEHICLE PROGRAM

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RECORD OF REVISIONS

Ltr	Authority	Signature	Date
A	AVRADCOM LTR 0025-JM-1491, 11 APR 1983 AVRADCOM LTR 0025-JM-1643, 11 JUL 1983 AVRADCOM LTR 0025-JM-1802, 30 September 1983	George F. Roberts	30 Sept. '83

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INTERFACE CONTROL DOCUMENT
FOR THE
U.S. ARMY RPV - FLIR MISSION PAYLOAD SUBSYSTEM

1. INTRODUCTION

1.1 Scope. This Interface Control Document (ICD) defines the electrical, mechanical, physical, thermal, and functional interfaces between the forward looking infrared (FLIR) mission payload subsystem (FMPS) and the remotely piloted vehicle (RPV) system. The interfaces defined include those with specific air vehicle (AV) subsystems: flight controls electronic package (FCEP), attitude reference assembly (ARA), and the modular integrated command and navigation system (MICNS). Both a mission payload subsystem (MPS), as used in the daylight RPV system, and an FMPS are required for the Aquila RPV System (YMQM-105). The AV and other RPV subsystems must be common to both payloads and both payloads must be interchangeable among air vehicles. The FMPS must be fully interchangeable with the MPS.

1.2 Purpose. This ICD is intended to provide technical information necessary to make the FMPS fully compatible with the RPV system. It defines the interface between the MPS and the remainder of the daylight RPV system.

2. APPLICABLE AND RELATED DOCUMENTS

2.1 Applicable Documents

2.1.1 Government Documents. The following documents form a part of this ICD to the extent specified herein.

SPECIFICATIONS

Military

MIL-E-5400R	31 Oct 75	Electronic Equipment, Airborne, General Specification for

STANDARDS

Military

MIL-STD-704C	30 Dec 77	Aircraft Electrical Power Characteristics

2.1.2 Non-Government Documents

STANDARDS

EIA-RS-330	Nov 66	Electrical Performance Standards for Closed Circuit Television Camera 525/60 Interlaced 2:1

INTERFACE CONTROL DOCUMENTS

HARRIS

Interface Control Drawing Electrical Interface	GCS/GDT 5030380
Interface Control Drawing Electrical	AV/ADT 5030381

2.2 Related Documents

The following documents are related to this Interface Control Document to the extent that they provide the detailed technical basis of data, and information contained herein. This IDC is subordinate to specification AV-SS-RPV-L10000 and all subtier specifications.

SPECIFICATIONS

Lockheed

System Specification for U.S. Army Remotely Piloted Vehicle	AV-SS-RPV-L10000A	SCN'S A01,A002,A03,A05,A06, A07,A08,A11,A12,A13,A16,A17, A19,A20,A21,A22,A23,A24,A25, A26,A27,A28,A29,A32,A35,A36 and A37 are incorporated in this letter revision.

Lockheed

Drawings & Specifications

Item	Document Number	Spec. Change Notice/Revision
Air Vehicle PIDS	5780911	02,03,06,A,A1,A3,A4
Flight Control Electronics Package CIDS	5780941	None
Attitude Reference Assembly CIDS	5780942	01,A,A1,A2,A3,A4,A5,A6, A7,A8,A9
Air Vehicle Flight CPDS	5781001	A,B,C,C1,C2,C3
Ground Control Station PIDS	5780915	01,02,03,04,05,07,08, 09,10,11,12,A,A1,A2,A3, A4,A6,A7,A9,A10
Mission Payload Operator Console CPDS	5781009	A,B,C,C2,C3
Ground Control Station Interface Unit CPDS	5781007	A,B,C,C1,D,D1
Ground Control Station Mission Operator CPDS	5781005	A,B,C
Mission Payload Subsystem PIDS	5780914	01,04,A,A1,A3,A4,A6, A7,A8,A11,A12,A14
Mission Payload Subsystem Tracker CPDS	5781523	A,B,C,C1,C2,C3
Recovery Subsystem PIDS	5780913	01,02,04,A,A2
Launch Subsystem PIDS	5780912	01,03,04,05,06,07, A,A1,A2,A3,B
Air Vehicle Aerodynamics, 3 View, General Arrangement (Dwg)	5781565C	None
Mission Payload Subsystem Interface Control (Dwg)	5781564D&E	None

3. REQUIREMENTS INTRODUCTION

3.1 Item Definition

3.1.1 System Configuration. The RPV system is comprised of an unmanned air vehicle (AV), a ground control station (GCS), the modular integrated communication and navigation system (MICNS) data link equipment, launch subsystem (LS), recovery subsystem (RS), support equipment, and associated training devices. The AV, with its mission payload subsystem (MPS), is controlled from the GCS, and target information is returned via the MICNS jam-resistant data link. The AV is a small, fixed-wing aircraft and includes provisions to accommodate an MPS.

The AV is controlled through an airborne data terminal (ADT) unit of the MICNS. The remote ground terminal (RGT) is the ground component of MICNS that tracks, transmits commands to, and receives data from the AV. The GCS is the truck-mounted, mobile operational control center of the RPV system and includes a mission planning facility, control and display consoles, a computer, tactical communications equipment, shelter, and a control and remoting unit that communicates with the RGT. The truck-mounted mobile launch subsystem accelerates the AV into the air by means of a catapult. The recoverv subsystem retrieves the AV at the completion of the mission. The recoverv system is truck mounted and mobile. It consists of a vertical-ribbon barrier net for capturing the AV, energy absorbers for decelerating the AV, and equipment to guide the AV automatically into the net. A parachute is provided as a emergency recovery means during test and training operations. The support equipment includes ground power generators, a maintenance shelter, ground test equipment, vehicles, trailers, and other equipment. An M882 truck (5/4-ton) equipped with a radio (AN/VRC-46) and speech security equipment (TSEC/KY-57) will be provided as Government-furnished equipment (GFE) for each RPV section. This vehicle will be used for liaison, resupply, and reconnaissance of positions.

3.1.2 <u>RPV Equipment.</u> The RPV system includes the following equipment:

(a) Air vehicle (including the payload)

(b) Remote ground terminal

(c) Ground control station

(d) Launch subsystem

(e) Recovery subsystem

(f) Support equipment

Figure 1 depicts the RPV equipment emplaced in a typical operational configuration.

3.1.2.1 <u>RPV Functional Areas.</u> The RPV system includes the following software functional areas which reside in the AV and GCS:

(a) Mission operations including prelaunch and built-in test

(b) Preflight

(c) Maintenance

(d) Training

The direct software interface between the AV and the MPS is further defined in AVF-CPCI-5781001. Control of the AV in flight from the GCS is according to GCS-CPCI-5781005.

3.1.3 <u>Missions.</u> The AV has multimission capability and operates beyond the forward line own troops (FLOT). The target acquisition and designation system performs or provides information for target acquisition, target designation, artillery adjustment, reconnaissance, and damage assessment. In peacetime, the RPV system will be used for operator and unit training, mobilization, and development of new and improved target acquisition, designation, and reconnaissance system concepts.

3.2 <u>Item Diagram.</u> The RPV system block diagram is shown in Fig. 2. Numbers in parentheses indicate paragraphs in the RPV System Specification AV-SS-RPV-L10000. Direct interfaces between the MPS and the air vehicle, the recovery subsystem, and the launch subsystem are described in Section 4.0.

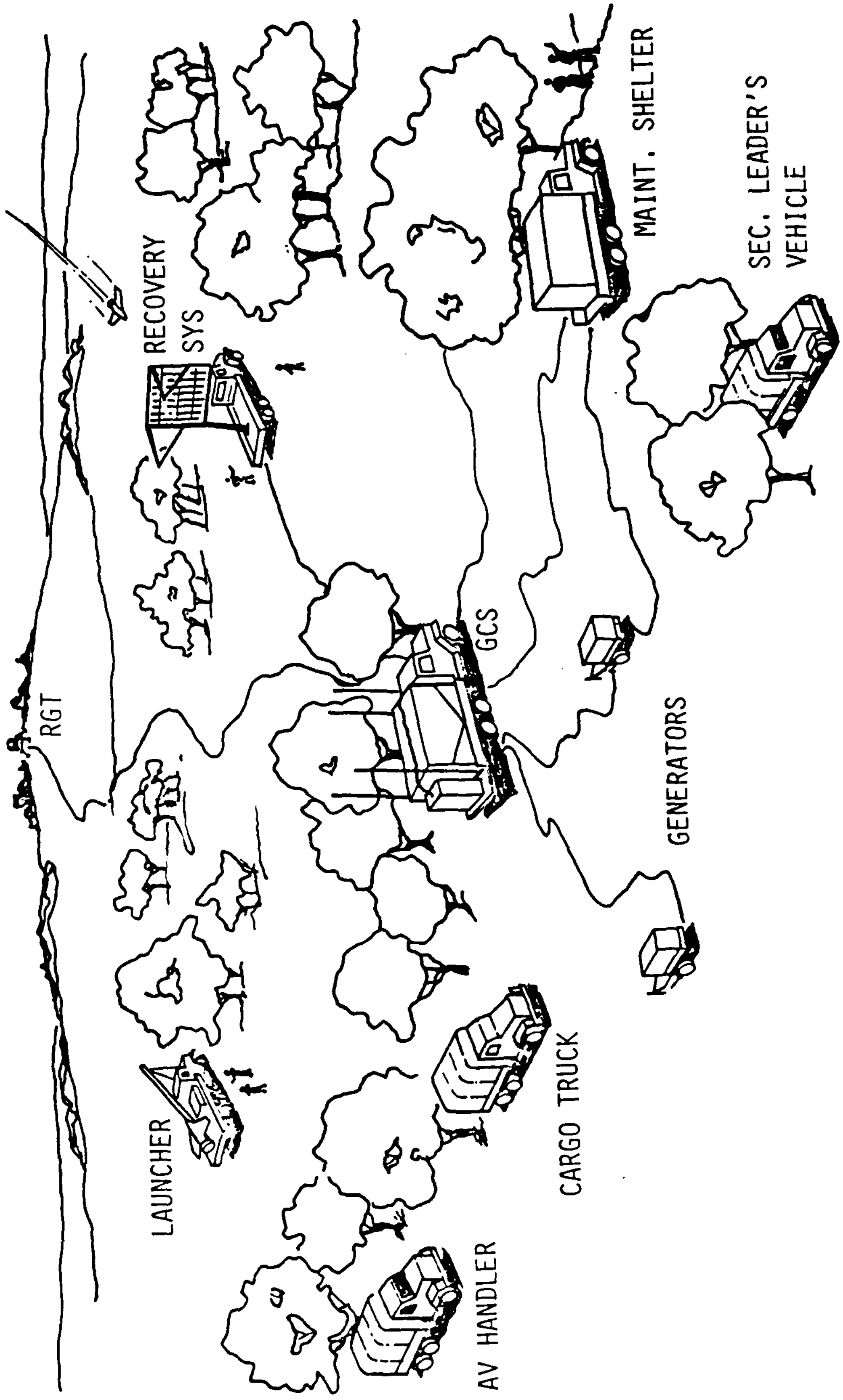


Fig. 1 RPV Eq pment

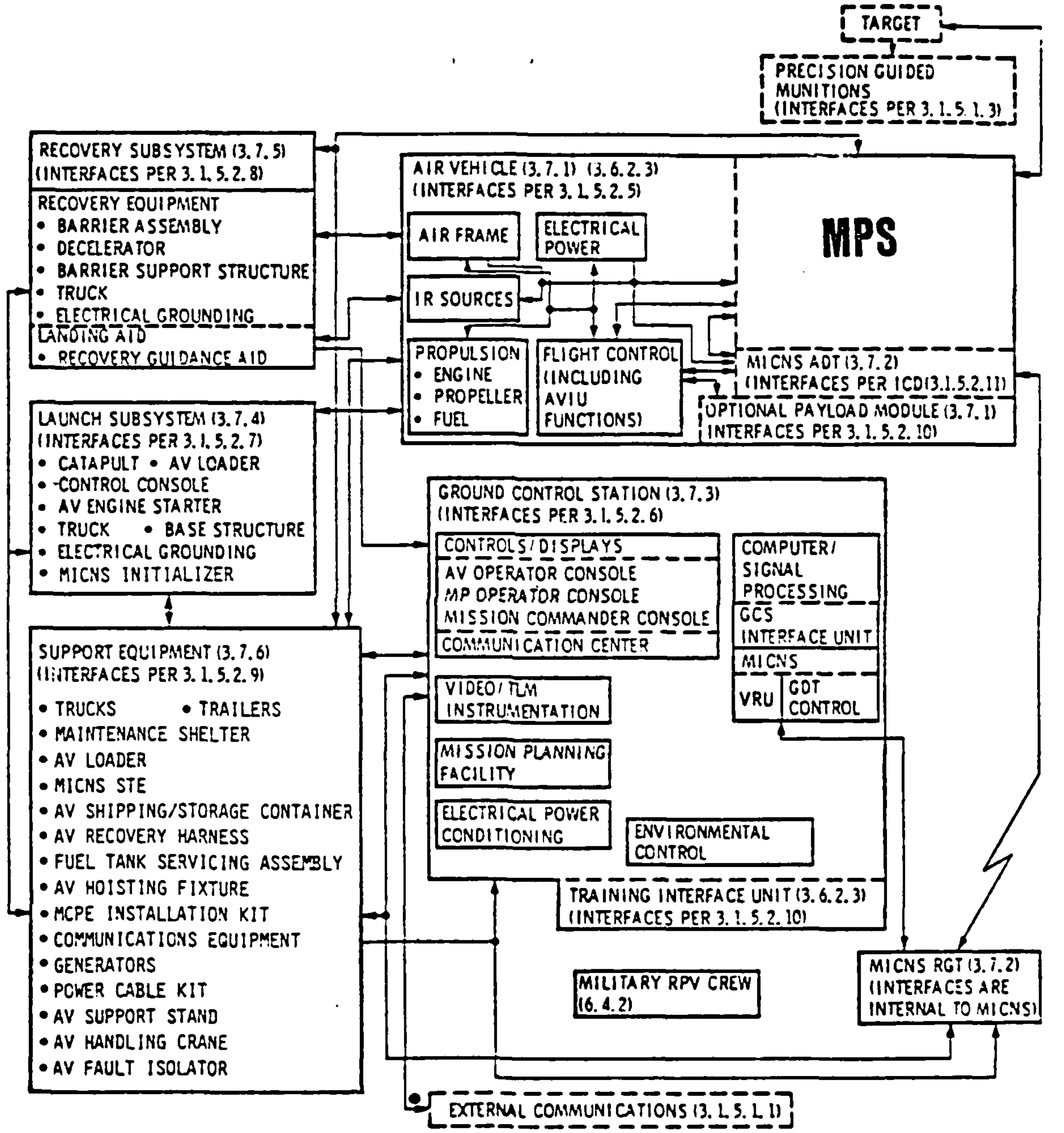


Fig. 2 RPV System Block Diagram

There is no direct interface between the MPS and the ground control station or the support equipment.

3.3 Materials, Processes, and Parts. All RPV system electrical and electronic subsystems are designed to conform to MIL-E-5400. MIL-P-11268 is the primary specification for the selection of electronic materials, processes, and parts. Electronic design and construction is such that all sensitive microcircuits are suitably protected from electronic damage during normal operations, testing, and maintenance.

3.4 Integration Testing. The RPV system contractor will conduct receiving inspection to detect shipping damage and verify that the FMPS is in operating condition prior to integration testing. The RPV system contractor will then conduct tests to determine compliance with the provisions of this ICD and the RPV System Specification AV-SS-RPV-L10000A. Integration testing will be conducted to provide assurance that the integrated system will meet all applicable requirements.

4. INTERFACE DEFINITION

The physical and functional interfaces have been established for the daylight RPV system with the MPS installed. This ICD defines this interface with the current (daylight) MPS.

The FMPS shall be fully interchangeable as one single unit with the daylight mission payload during tactical deployment of the RPV system without requiring other changes to directly or indirectly interfacing ground support and air vehicle equipment, except as required as part of the removal and installation process of the payload itself.

As specified in the following paragraphs, interface definition entails not only those interfaces associated with the AV but also system implications

associated with the data link, the ground control station, launch and recovery, as well as operational aspects of the RPV system.

4.1 <u>AV Physical Interface and Coordinate System.</u> The AV general arrangement is shown in Fig. 3 and the internal arrangement in Fig. 4 for the baseline Aquila AV configuration. This and subsequent sections describe the daylight mission payload subsystem within the AV. This is the payload for the baseline Aquila system.

A conventional aircraft coordinate system is used to locate specific points on the AV and its subsystems. The positive directions of the XYZ axis set are indicated on Fig. 4. The origin of the reference coordinate system is at an arbitrary point forward and below the vehicle nose. The terms fuselage station (FS), butt line (BL), and water line (WL) are used to denote the X, Y, and Z coordinates, respectively.

4.1.1 <u>Payload Location and Envelope.</u> The mission payload compartment contains the payload and attitude reference assembly (ARA). The compartment is approximately 22 in. long, 19 in. wide, and 10 in. high and is located between two fuselage bulkheads at FS 111.28 and FS 133.36, as shown in Figs. 5 and 6. The compartment also provides space for air ducts, flight test instrumentation, maintenance tool access, and cable harnesses/race ways between the forward and rear compartments of the AV. In addition, there is an allowance for excursion clearance for motion of the payload and the ARA relative to the airframe. The allocated volume in the payload compartment is approximately 5,100 in^3.

A removable hatch, located on the topside of the compartment, covers an access opening of approximately 18 in. x 22 in. The bottom of the compartment consists of the payload pallet, which is part of the AV air frame structure and is the structual support for the mission payload. The pallet has a 14-in.-diameter opening to allow the mission payload turret to project beneath

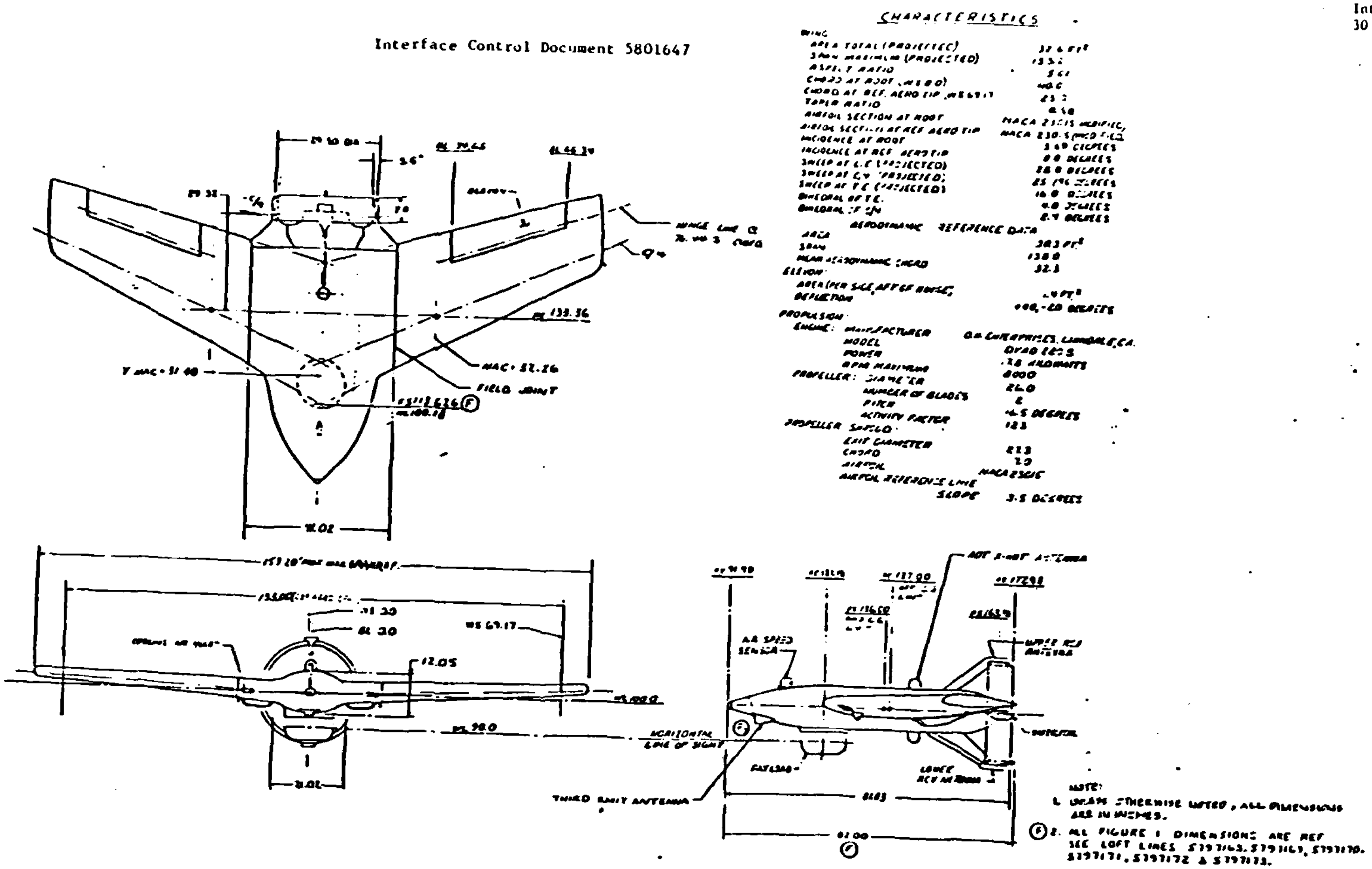


Fig. 3 AV GENERAL ARRANGEMENT

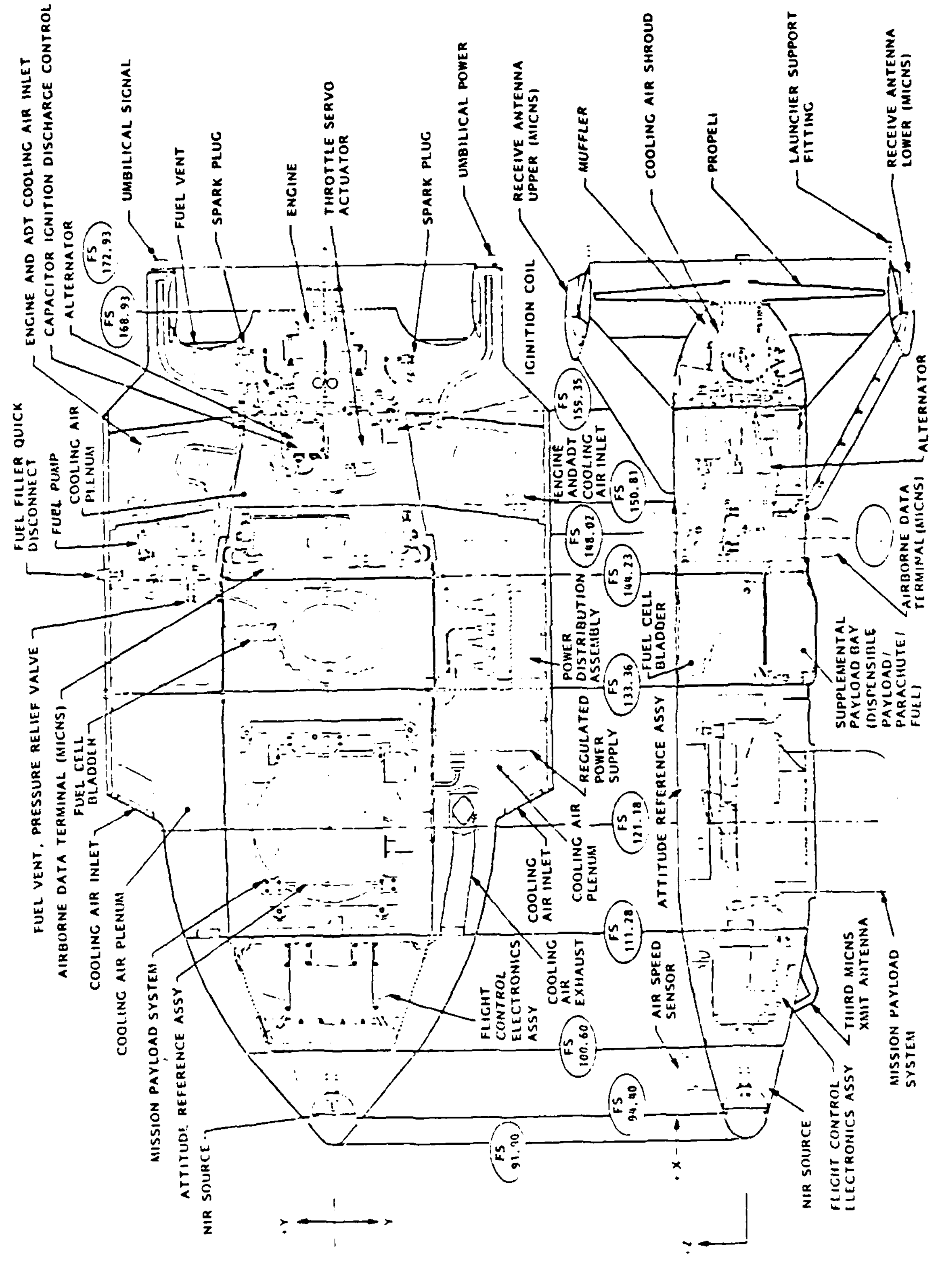
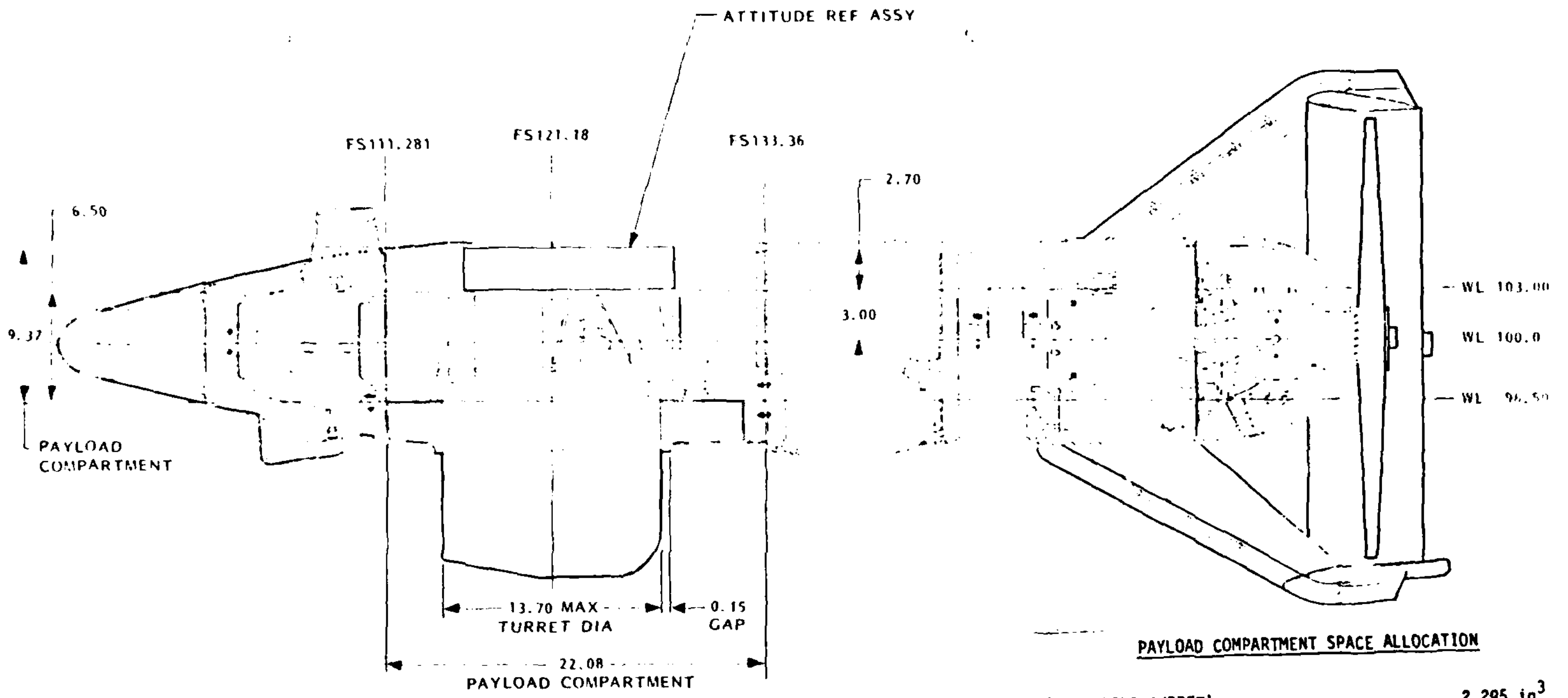


Fig. 4 AV Internal Arrangement



PAYLOAD COMPARTMENT SPACE ALLOCATION

MPS (EXCLUDING TURRET)	2,295 in^3
ARA	300 in^3
CABLE HARNESSES (EST.)	157 in^3
AIR DUCTS (EST.)	24 in^3
FLIGHT INSTRUMENTATION RESERVED (EST.)	750 in^3
TOTAL ACCESS SPACE & CLEARANCE VOLUME (EST.)	1,324 in^3
MISCELLANEOUS STRUCTURE (BRACKETS, ETC) (EST.)	250 in^3
TOTAL PAYLOAD COMPARTMENT VOLUME	5,100 in^3

Fig. 5 MPS Installation (Side View)

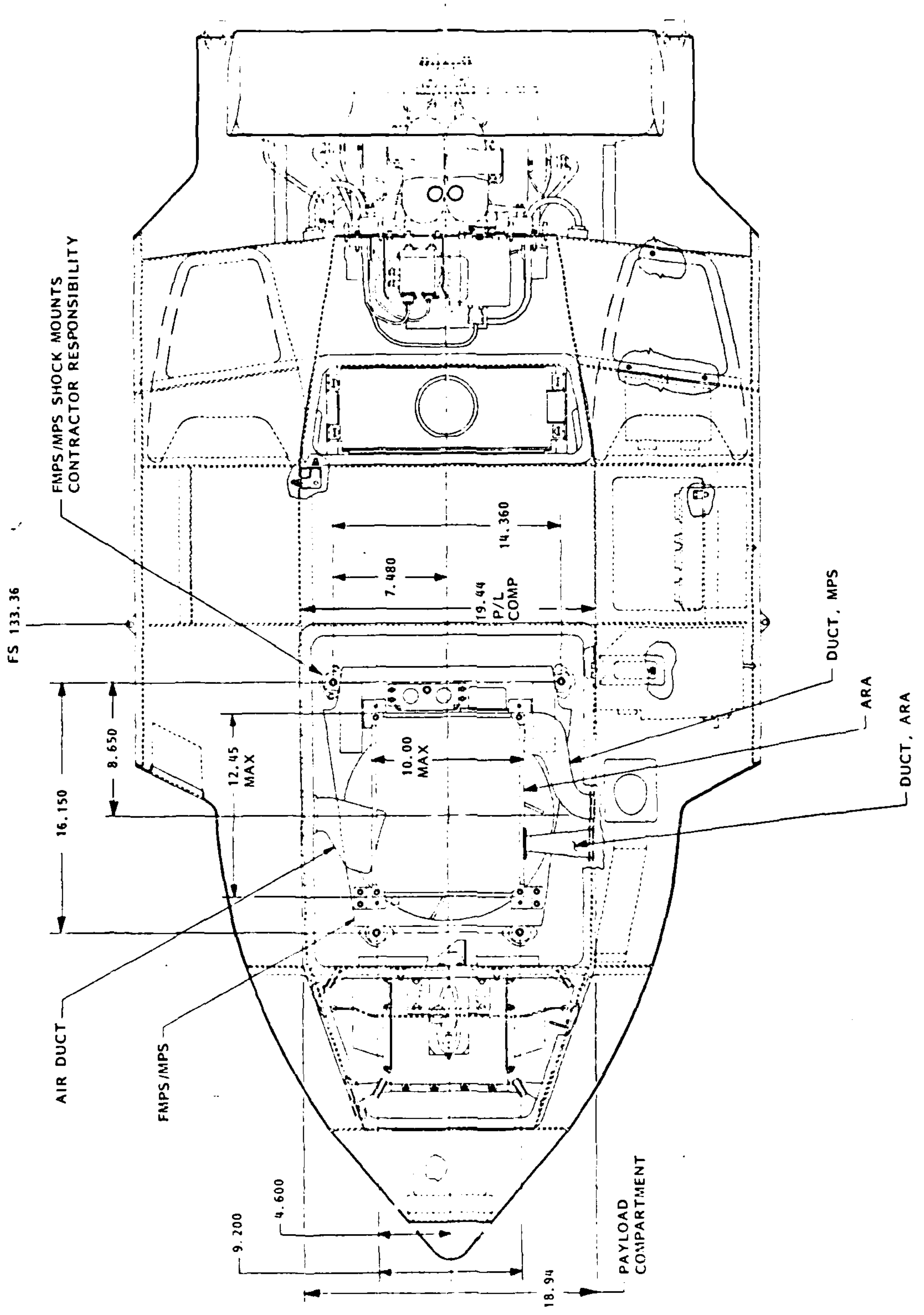


Fig. 6 MPS Installation (Top View)

the fuselage. Details of the compartment envelope, including location of the electrical power/signal connectors, are shown in Fig. 7.

4.1.2 Payload Weight and CG Envelope. The maximum allowable design weight for mission payloads is 59.5 lb. The corresponding minimum allowable payload weight is 42.0 lb. The payload center of gravity is located as follows:

Vehicle Axis	Nominal CG	Allowable Variation
Longitudinal	F.S. 122.20	+2.0, -1.0
Lateral	B.L. 0.	± 0.5
Vertical	W.L. 96.0	± 2.0

4.1.3 AV Structural Loads, Vibration, and Mounting Constraints

4.1.3.1 Structural Design Conditions. The MPS is designed to meet the structural design load factors derived from the combination of linear load factors in Fig. 8 plus the load factors due to predicted angular accelerations as given below:

Condition	Axis	Velocity (rad/sec)	Acceleration (rad/sec^2)
Flight maneuvers	Pitch	± 0.5	± 5.0
	Yaw	± 0.5	± 2.0
	Roll	± 0.5	± 10.0
Recovery net engagement	Pitch	± 5.0	± 20.0
	Yaw	±12.0	±200.0
	Roll	± 3.0	± 20.0

The structural design airspeeds to be used for payload operation in flight are:

Speed	km/h (knots) EAS*
Design cruising	150 (81)
Max level flight	200 (108)
Limit speed	230 (124)

*Equivalent airspeed

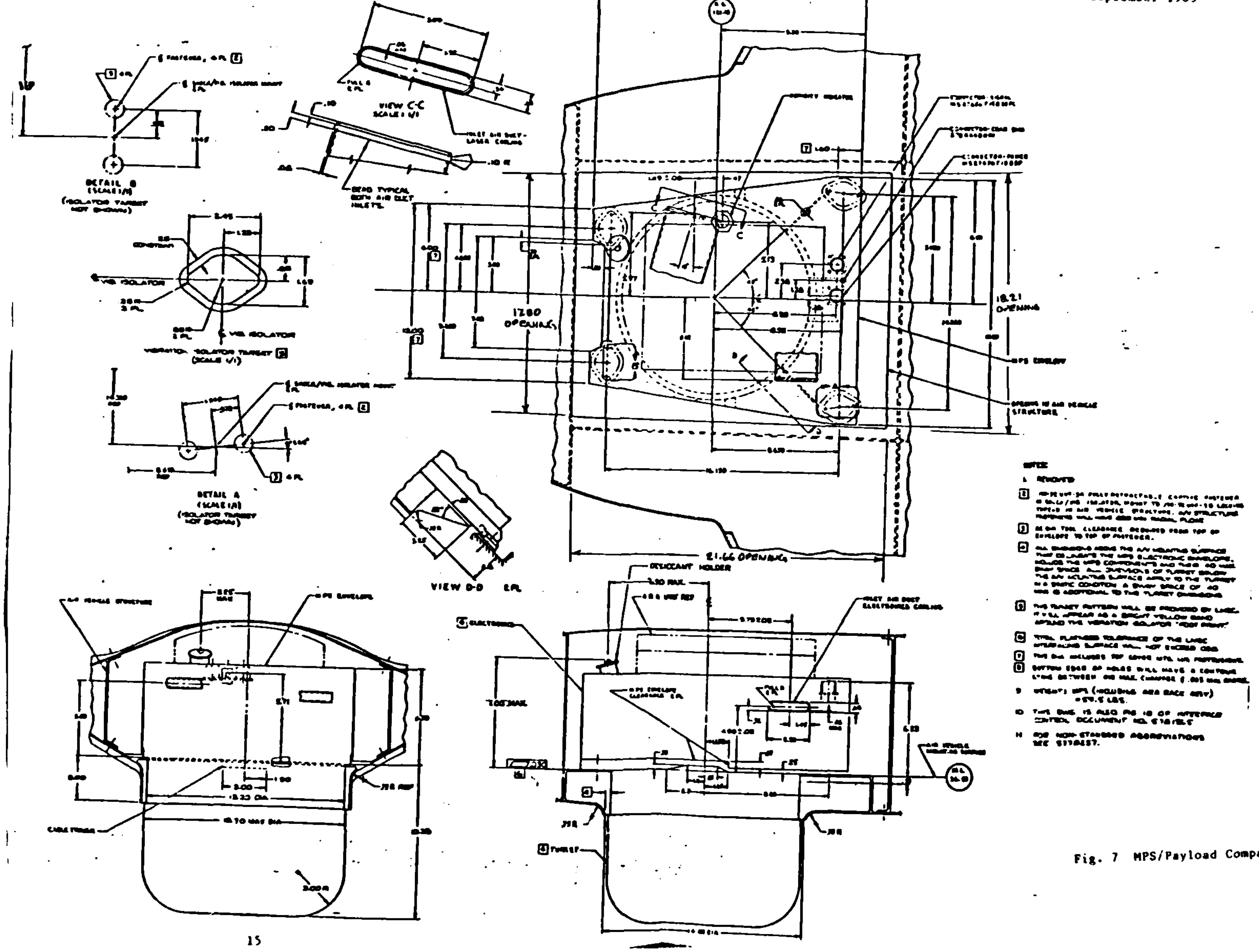
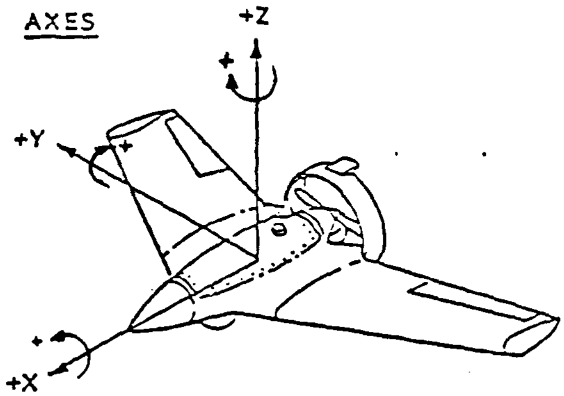


Fig. 7 MPS/Payload Compartment



CG: STA 136.5 ± 0.5
WL 100

MAX LIMIT LOAD FACTORS AT DGW (NOT TO BE COMBINED)

AXIS	GROUND HANDLING	LAUNCHER TRANSPORT	LAUNCH	FLIGHT	NET RETRIEVAL	PARACHUTE DEPLOYMENT
X	+2g -2g	+2g -2g	+8g -2g	+1g -1g	+2g -8g	+8g -8g
Y	+2g -2g	+2g -2g	+1g -1g	+1g -1g	+2g -2g	+8g -8g
Z	+2g -2g	+3g -1g	+3g -1g	+4.7g(+5.4)g -2.7g(-3.4)g	+2g(+4g) -2g(-4g)	+8g -8g

NOTE: THE QUANTITIES IN PARENTHESIS REPRESENT LOAD FACTORS FOR GUST CONDITIONS AT MINIMUM AIR VEHICLE WEIGHT (176 LBS.) AND ARE TO BE USED FOR MPS ATTACH LOADS. LOADS EXPERIENCED UPON IMPACT AFTER PARACHUTE DEPLOYMENT ARE DESIGNED TO KEEP THE MPS FROM TEARING LOOSE.

ULTIMATE LOAD FACTORS

GROUND HANDLING, FLIGHT, PARACHUTE DEPLOYMENT } ULTIMATE = 1.25 X MAX. LIMIT

LAUNCHER TRANSPORT, LAUNCH, NET RETRIEVAL } ULTIMATE = 1.2 X 1.25 X MAX. LIMIT

NOTE: LOADS ON EQUIPMENT ARE POSITIVE IN THE OPPOSITE DIRECTION FROM THE DIRECTION OF AIR VEHICLE AXIS.

Fig. 8 AV Structural Design Load Factors

External components of the payload will be subjected to maximum dynamic pressure at limit speed, 230 km/h (124 knots). At this speed, dynamic pressure is 2,500 n/m^2 (52 lb/ft^2). The payload hanging below the fuselage is not directly subjected to recovery net strap loads, however, limited contact with the straps may occur during the deceleration motion in the net.

4.1.3.2 Vibration. The MPS is exposed to structure-transmitted vibration during all phases of flight. The vibration environment on the payload pallet is primarily sinusoidal, at a fundamental frequency corresponding to engine speed (variable), and higher harmonics. The envelope of sinusoidal vibration levels at the MPS interface is shown in Table I. These levels apply to the X, Y, or Z direction, separately (i.e., nonsimultaneously) at the four mission payload attach points to the pallet as shown in Fig. 9.

Table I

SINUSOIDAL VIBRATION ENVELOPE AT FMPS INTERFACE WITH PAYLOAD PALLET

Frequency (Hz)	Amplitude (g, zero-peak)
5 - 500	1.5
500 - 2,000	4.0

4.1.3.3 Mounting. The daylight payload mounts on vibration isolators to four support points on the payload pallet. This interface is located at WL 96.50 (Fig. 6) and is described in detail in Fig. 9. Mission payloads may be hard- or soft-mounted, but isolators, if used, are considered to be part of the mission payload weight allocation.

The MPS is the structural support for the ARA package which weighs 9.0 lb. The ARA is hard-mounted to the top of the daylight mission payload, so that its XYZ axes are aligned with respect to the payload axes to within 2 milliradians. Figure 10 shows the mechanical interface detail, including

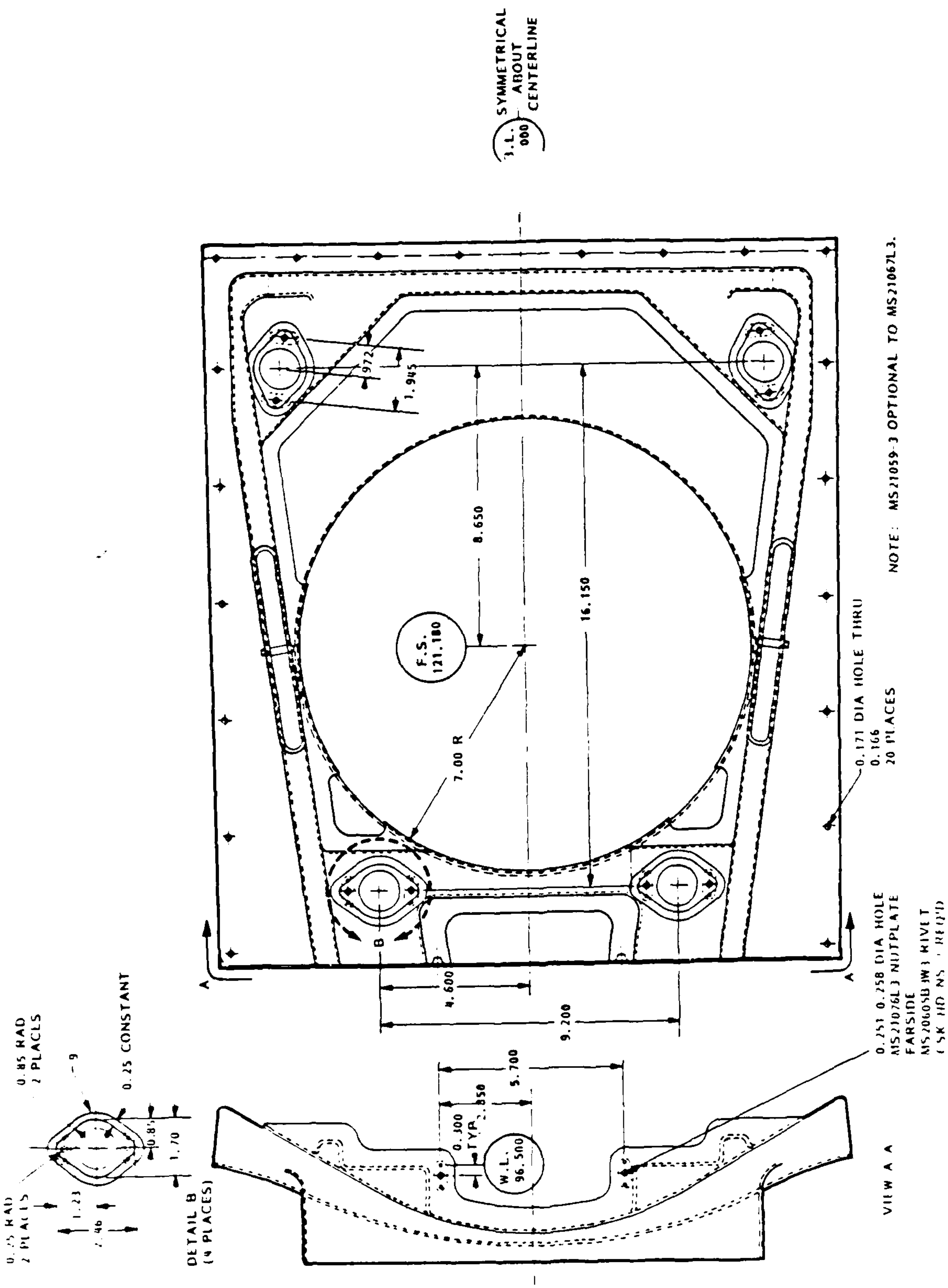


Fig. 9 MPS Pallet

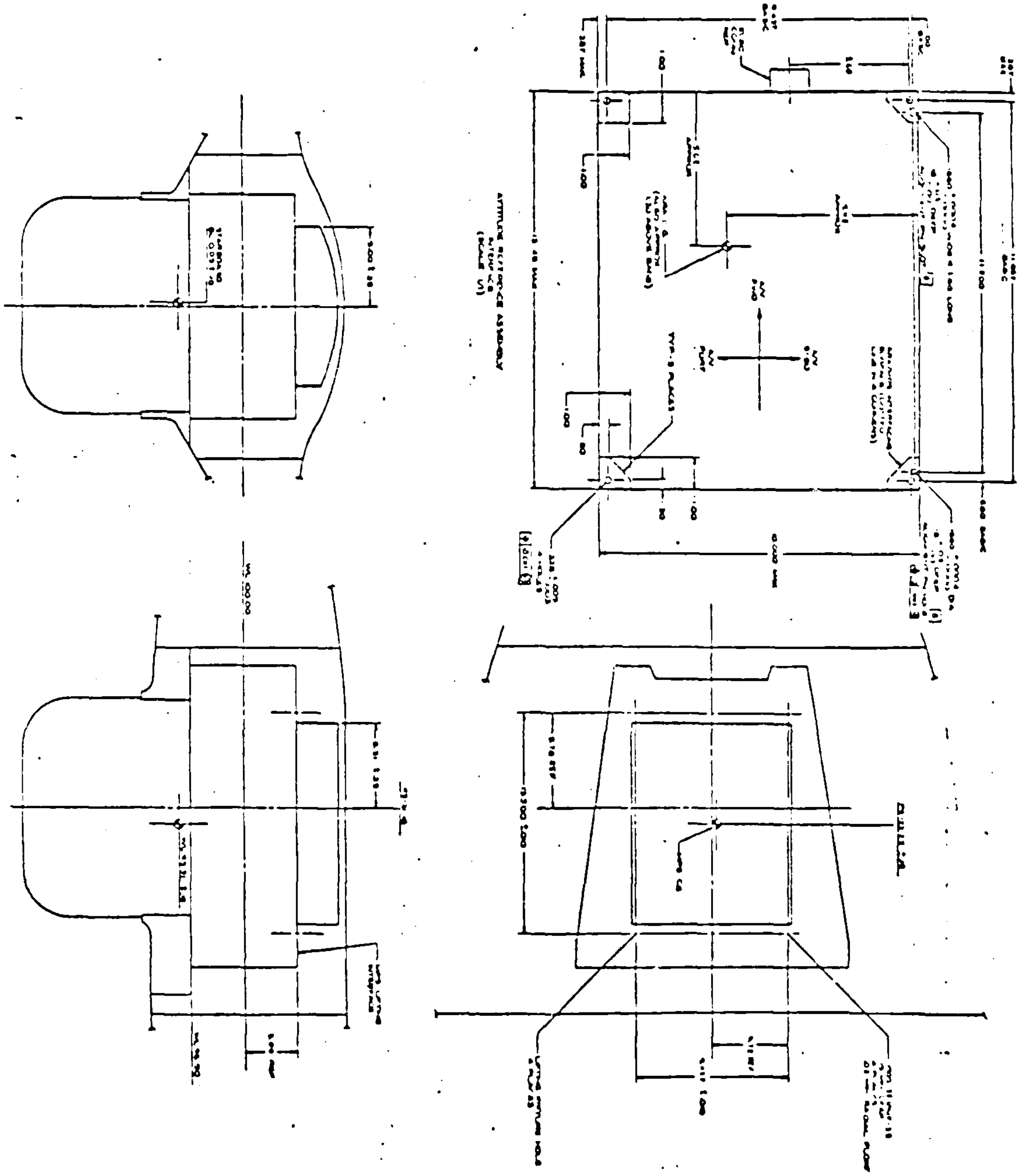


Fig. 10 ARA/MPS Mechanical Interface

guide pins/slots for mechanical alignment of the ARA to the payload. Direct contact between the two units is limited to the mating surfaces at the four corners of the ARA to minimize and to localize mechanical vibration effects across the interface. The clearance between the two units is sufficient to clear four soft rubber bumpers (0.44-in. maximum protrusion, not shown) on the ARA baseplate to minimize bench handling shock when the unit is separated from the payload. These bumpers lie entirely within the ARA package envelope and do not affect the payload/ARA interface.

4.1.4 Payload Package Heat Exchange and Cooling

4.1.4.1 Altitude - Temperature Envelope. The altitude-air temperature flight envelope shown in Fig. 11a. The design condition for AV equipment cooling is sea level pressure altitude, 52°C (126°F) hot day. In addition, there is a design condition for the nonoperating case during MPS transportation of -25°F to +160°F.

Prior to prelaunch checkout, payload equipment is assumed to have an initial temperature equal to ambient outside air temperature between extremes of -32°C (-25°F) to +52°C (+125°F).

4.1.4.2 Cooling Provisions. Cooling air is provided from ram air intakes in the wing roots of the AV and is ducted directly to the mission payload through plenums located on each side of the payload compartment. The location of these plenums, their orientation, and their cross-section detail are defined on Fig. 7. Venting to the atmosphere occurs around the rear portion of the mission payload turret through the gap between the turret and the fuselage opening (Fig. 5) and through two slots in the AV skin adjacent to the sides of the turret. The difference in pressure and in air flow between the inlet plenums and the exhaust openings is defined as the payload pressure head and payload airflow, respectively. At the design conditions specified in para 4.1.4.1, the available air flow for the MPS is given in Fig. 11b. This curve represents the maximum air flow available for mission payload cooling purposes, recognizing that the actual air flow is determined by the resistance

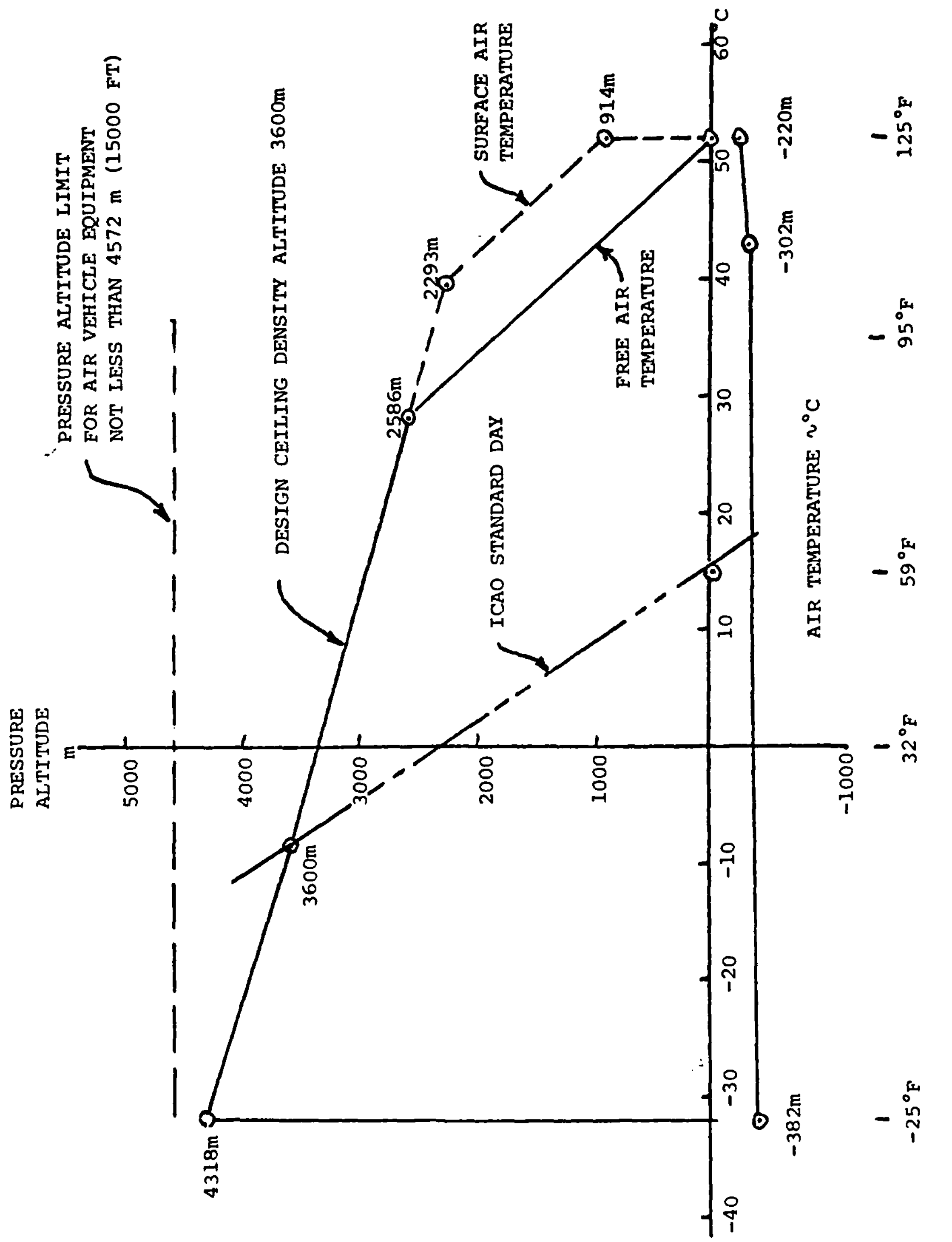


Fig. 11a Flight Envelope

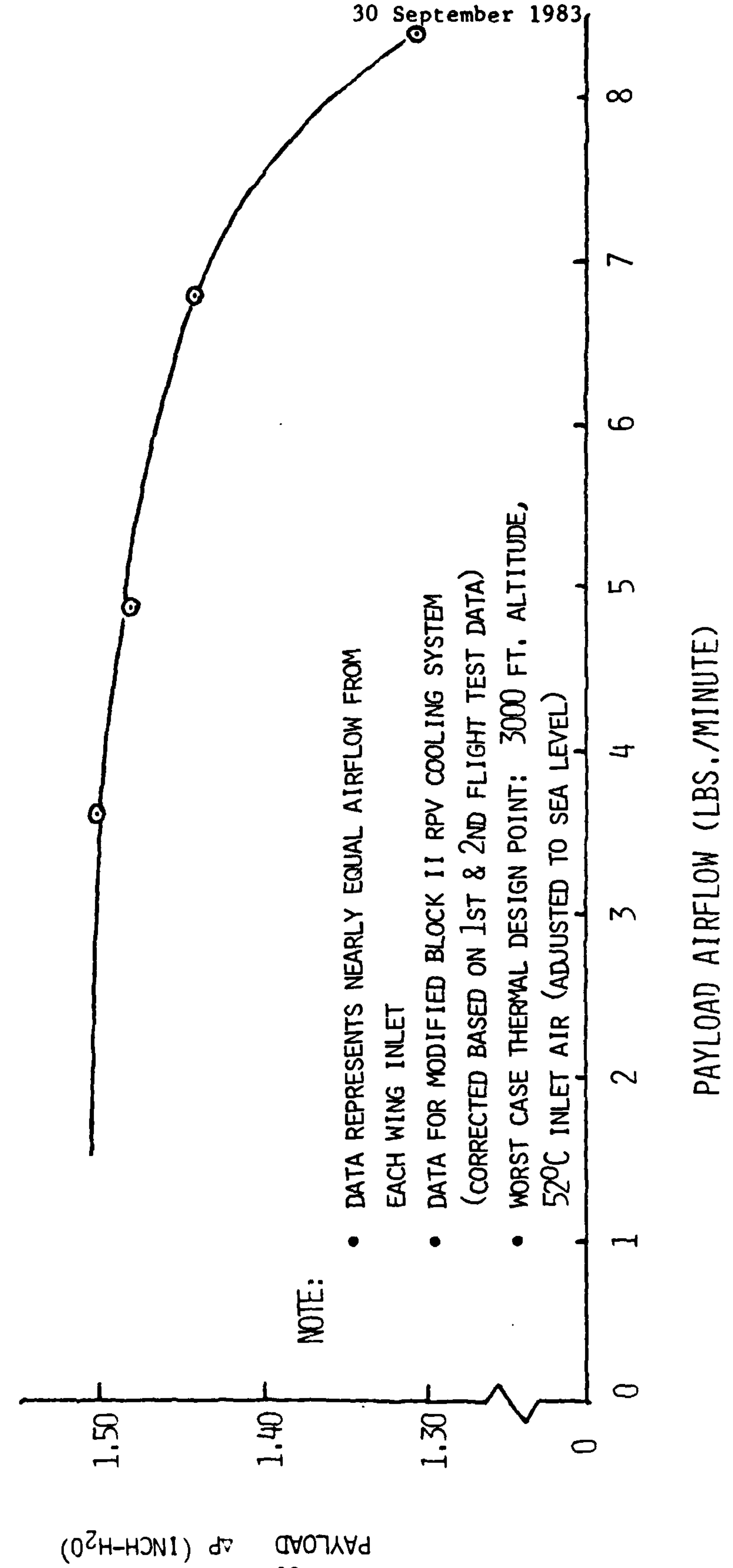


Fig. 11b Available Payload Pressure Head as a Function of Payload Total Air Flow

Table II

MPS OPERATING CONDITIONS WITHOUT COOLING AIR

(Ground Test Operations)

Operating Condition	Ambient Temperature (external)	Operating Time (min)	Performance
MPS on Laser off	126°F (52°C)	5 minimum	To Spec
MPS off Laser off	160°F (71°C)	none	non-operating
MPS on Laser on (20 Hz)	126°F (52°C)	1 minimum	To Spec
MPS on Laser on (20 Hz)	-26°F (-32°C)	10 minimum	To Spec

of duct connections and mission payload cooling passages. The daylight payload is required to operate without cooling for short periods of time under operating conditions as specified in Table II.

4.1.5 Flight Characteristics. The AV flight characteristics are described below.

4.1.5.1 Flight Control. The AV is controlled by the flight control electronics package using commands preprogrammed and stored in the AV computer system and/or the GCS computer system. The AV proceeds under waypoint guidance with provisions for maneuvers between or at each waypoint. AV guidance and navigation include instructions for airspeed, altitude, heading, heading rate, and maneuver definitions. The AV aerodynamic flight controls comprise a two-axis system - pitch and roll. Roll to turn is used to change flight path heading. The flight control system computes AV pitch and roll angles and provides this information to the daylight payload.

4.1.5.2 Flight Attitude and Body Motion. The AV flight attitude changes with airspeed, altitude, weight, climb, descent, and turns. At design

conditions (243-lb weight, 1,200-m (3,937-ft) altitude, 35°C (95°F) hot day), typical trim attitudes for steady-state flight are:

Flight Condition	Airspeed km/h (knots) TAS**	Body Pitch Attitude* (deg)
Loiter	130 (70)	+8
Cruise	150 (81)	+6
Max speed	187 (101)	+3
Climb	130 (70)	+12
Descent	130 (70)	+3

(includes approach to net)

*Angle between fuselage WL 100 and local horizontal (+ denotes nose high)
**True Air Speed

Residual body motion, depending on air turbulence, is less than:

Body Axis	Amplitude	Frequency
Pitch	±3 deg	0.5 Hz
Yaw	±5 deg	0.5 Hz
Roll	±5 deg	1.0 Hz

4.1.5.3 Maneuver Characteristics. The AV maneuvering characteristics, with roll to turn, are:

Flight Condition	Airspeed km/h (knots) TAS	Roll Angle (deg)	Heading Rate (deg/sec)	Turn Radius m (ft)
Loiter	130 (70)	30	9.0	230 (755)
Cruise	150 (81)	30	7.8	310 (1017)

The AV is capable of executing banked turns of up to ±40 deg bank angles at rates of up to 50 deg/sec in roll, 30 deg/sec in pitch, and 15 deg/sec in heading. The AV is also capable of performing evasive jinking maneuvers with roll angles up to ±60 deg (12-second period) and pitch angles up to ±15 deg (6-second period).

4.1.5.4 Payload Aerodynamic Effects. External payload protuberances will affect AV aerodynamic drag and stability. Mission payload drag characteristics do not exceed:

$$C_D S = 0.37 \text{ ft}^2$$

where:

C_D = payload drag coefficient, nondimensional
S = payload reference area, ft^2

4.2 AV Electrical Power Interface. The physical location of MPS connectors is shown in Fig. 7.

4.2.1 Voltage and Power. The AV electrical power to the payload is 28 Vdc unregulated power (as defined in MIL-STD-704). Power available to the payload is 600 W average and 800 W peak (no greater than 5 sec). During the launch and recovery phases of the AV operation, power is limited to 300 W average and 500 W peak. There is no specific duty cycle.

.2.1.1 Power Connector. The power connector is MS27656T15B5P with size 16 contacts. The connector location is shown on Fig. 7. Connections are as shown in Figs. 12 and 13. Noted are interface connectors and wiring between the mission payload subsystem (MPS), the flight controls electronics package (FCEP), and the attitude reference assembly (ARA).

4.2.2 Power Regulation and Supply. Power characteristics are as stated in MIL-STD-704 for 28 Vdc unregulated aircraft power.

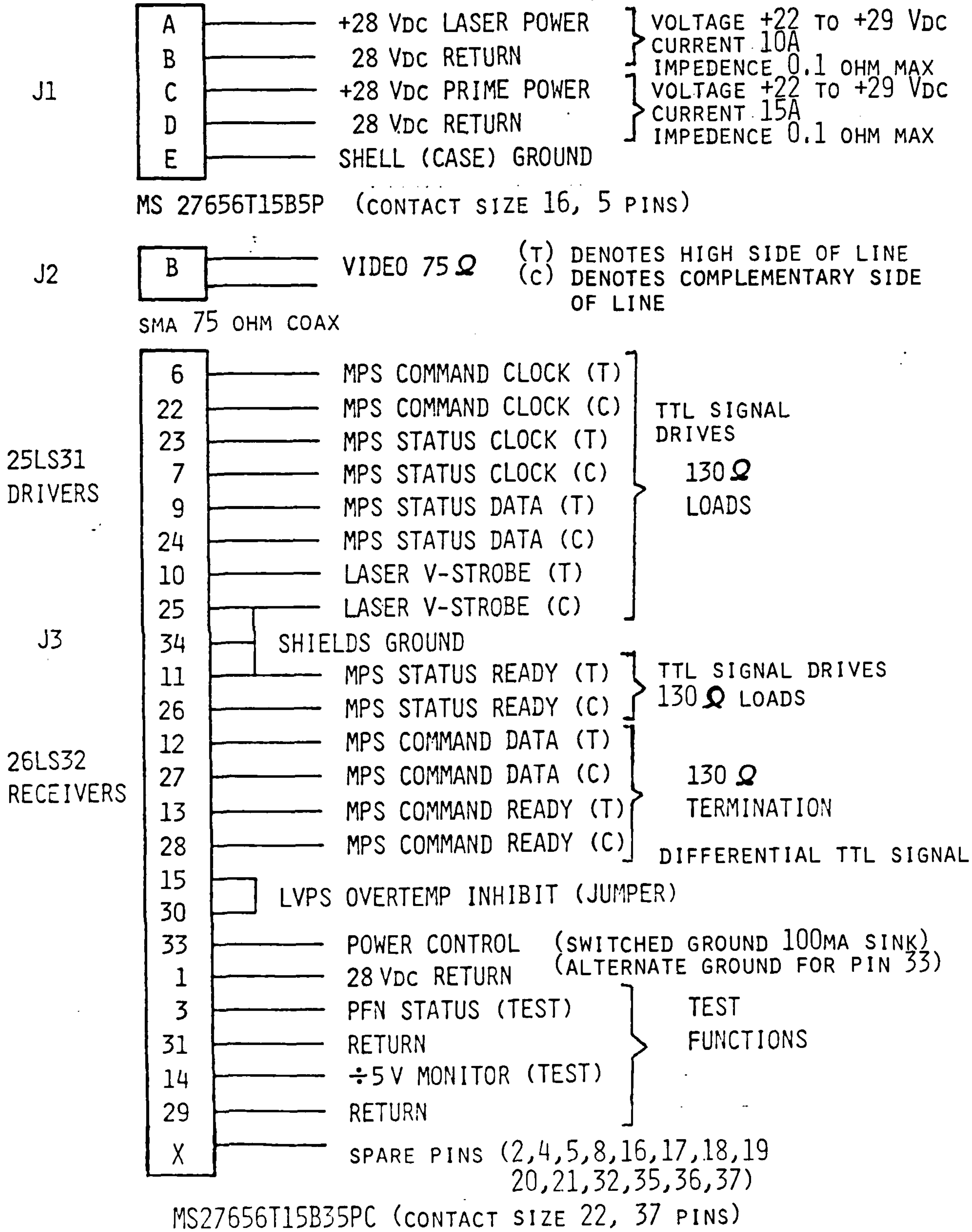


Fig. 12 MPS Interface Connectors

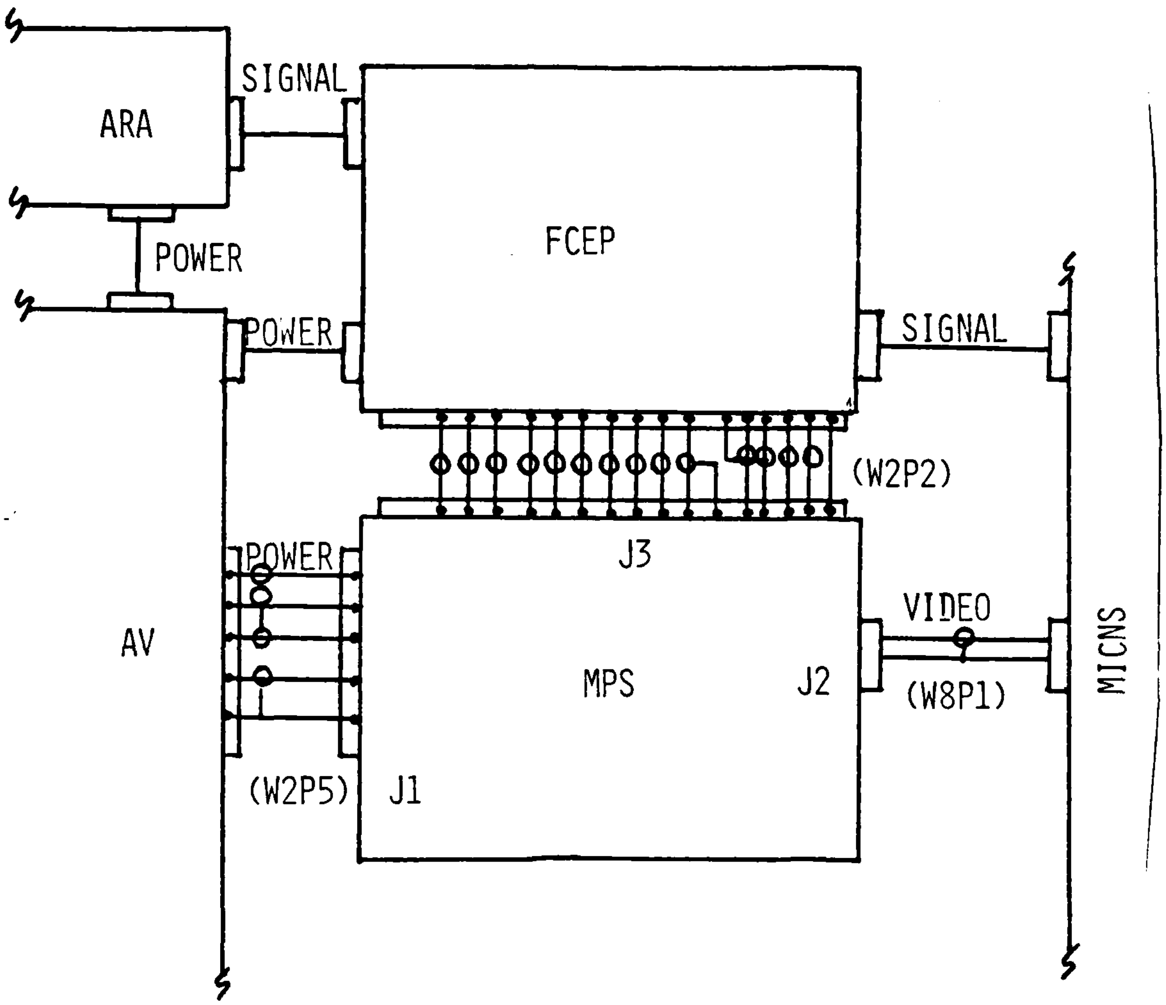


Fig. 13 MPS Wiring Interface Diagram

4.2.2.1 Power Switching and Protection. A power control line derived from a switching circuit capable of sinking 100 mA to the return line is provided for the 28 Vdc prime power line. Transient suppression circuitry must be provided in alternate payloads to minimize voltage transients on these power lines. Circuit breakers are provided on each 28 Vdc line in order to prevent electrical short circuits from degrading the AV electrical power system. The MS3320 family (or equivalent) of circuit breakers are used for this application.

4.3 Electrical Signal Interfaces

4.3.1 General. The MPS conforms to the signal interface shown in Table III. Implementation is through two connectors:

J2, the video interface coaxial cable connection which transmits the composite video signal directly to the MICNS; and

J3, the signal interface multipin connection to the FCEP which carries:

(a) Two serial data signals that transmit COMMAND data into and STATUS data out of the MPS,

(b) Two CLOCK signals from the MPS for synchronizing the COMMAND and STATUS data interface,

(c) Two READY signals that indicate when the COMMAND and STATUS data may be transferred,

(d) A LASER V-STROBE signal which is a synchronizing pulse, generated only in the range mode, used to obtain precise MPS pointing data on a designated target, and

(e) A control circuit to turn on the 28-V MPS primary power.

Table III

MPS SIGNAL INTERFACE CONNECTIONS

CONNECTOR	MPS PIN NO.	SIGNAL FUNCTION	SOURCE	DESTINATION -PIN NO	DESCRIPTION
J2 VIDEO	COAX	COMPOSITE VIDEO	MPS	MICNS VIDEO IN	EIA RS-330 FORMAT, EXCEPT NON-INTERLACED, 30 FRAMES/SEC.
J3 SIGNAL	6 22	MPS COMMAND CLOCK (T) MPS COMMAND CLOCK (C)	MPS	FCEP 49 48	105 KBPS CLOCK, DIFFERENTIAL TTL SIGNAL
	23 7	MPS STATUS CLOCK (T) MPS STATUS CLOCK (C)	MPS	FCEP 42 41	105 KBPS CLOCK, DIFFERENTIAL TTL SIGNAL
	9 24	MPS STATUS DATA (T) MPS STATUS DATA (C)	MPS	FCEP 39 40	105 KBPS NRZ SERIAL DATA, DIFFERENTIAL TTL SIGNAL
	10 25	LASER V - STROBE (T) LASER V - STROBE (C)	MPS	FCEP 53 52	LOGIC LEVEL, DIFFERENTIAL TTL SIGNAL 110 μsec PULSE WIDTH; GENERATED ONLY IN RANGE MODE, TRAILING EDGE OF PULSE OCCURS WITHIN 1 μsec AFTER ACTIVE TIMING COMMAND TO FIRE LASER
	11 26	MPS STATUS READY (T) MPS STATUS READY (C)	MPS	FCEP 38 37	LOGIC LEVEL, DIFFERENTIAL TTL SIGNAL
	12 27	MPS COMMAND DATA (T) MPS COMMAND DATA (C)	FCEP 50 51	MPS	105 KBPS NRZ SERIAL DATA, DIFFERENTIAL TTL SIGNAL
	13 28	MPS COMMAND READY (T) MPS COMMAND READY (C)	FCEP 63 64	MPS	LOGIC LEVEL, DIFFERENTIAL TTL SIGNAL
	15 30	LVPS OVERTEMP INHIBIT	MPS	MPS	JUMPER PIN 15 TO PIN 30 IN AV CONNECTOR W2P2
	33	+28 Vdc PRIMARY POWER CONTROL	FCEP 26	MPS	SWITCHED GROUND TO TURN ON MPS PRIMARY POWER

4.3.1.1 Payload/FCEP Signal Interface. The FCEP is the source of command data for control of the payload and the recipient of serial digital data from the payload. Serial data to or from the FCEP is transferred at a nominal bit rate of 100 kb/s. Serial data is received and transmitted in message blocks, each containing 256 predetermined bits per message. The number of messages per second is less than or equal to 30.

Figure 14 shows the data transfer timing that applies for COMMAND and STATUS data and their associated CLOCK and READY signals. Each data block consists of eight 16-bit words (128 bits per block) with byte 0 identifying the block (see Fig. 25). A total of ten blocks are assigned to the MPS, five for COMMAND and five for STATUS. Figures 15 through 19 and Tables IV through VIII describe the COMMAND data format in detail. COMMAND updates are provided for all high-rate data at a rate of ten (10) updates per second. Other data have single-shot or lower rate updating. The STATUS data includes all data available from the MPS. Figures 20 through 24 and Tables IX through XII describe the STATUS data format in detail. The MPS updates this data consistent with the required update rates. Maximum allowable data skew for the range mode is one millisecond. MPS data transfer sequence and update rates are shown in Fig. 25.

4.3.1.2 Payload/MICNS Interface. Video signals from the mission payload are transferred directly to the MICNS air data terminal (ADT) in the air vehicle. The daylight MPS/MICNS ADT interface is described in detail in Interface Control Document 5030381. Video output is composite video following the EIA Standard RS-330 format, except that it is noninterlaced at nominal 30 frames/second. Each frame contains the equivalent of 525 sequentially written lines in video space. The detailed format is shown in Fig. 26. The output impedance is 75 ± 3.75 ohms, and the video output is decoupled from an emitter follower output stage. The video short circuit dc current does not exceed 100 mA. The sync pulse height remains within the tolerance indicated in Fig. 26 over the MPS operating temperature range.

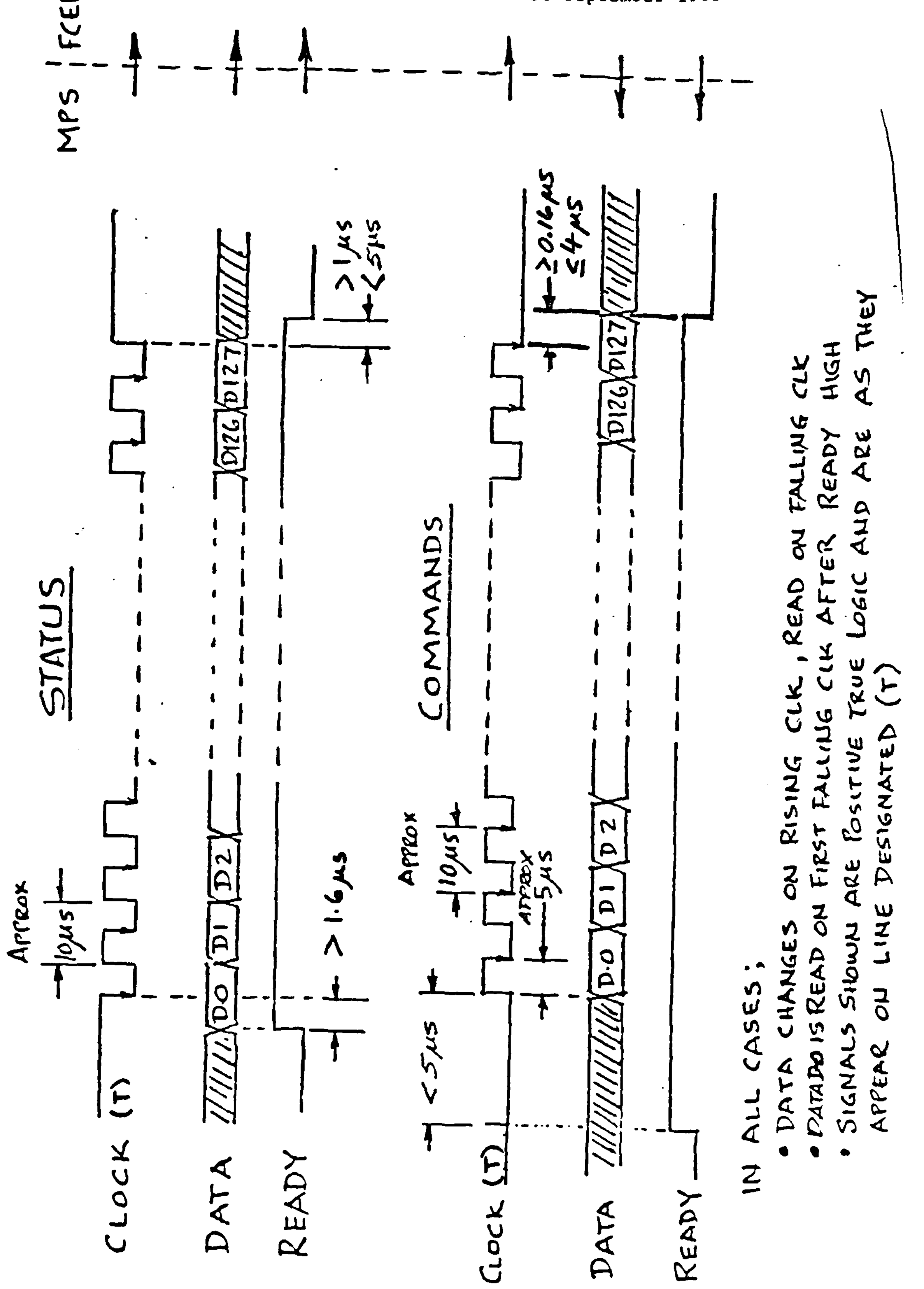


Fig. 14 Serial Data Timing Relationship

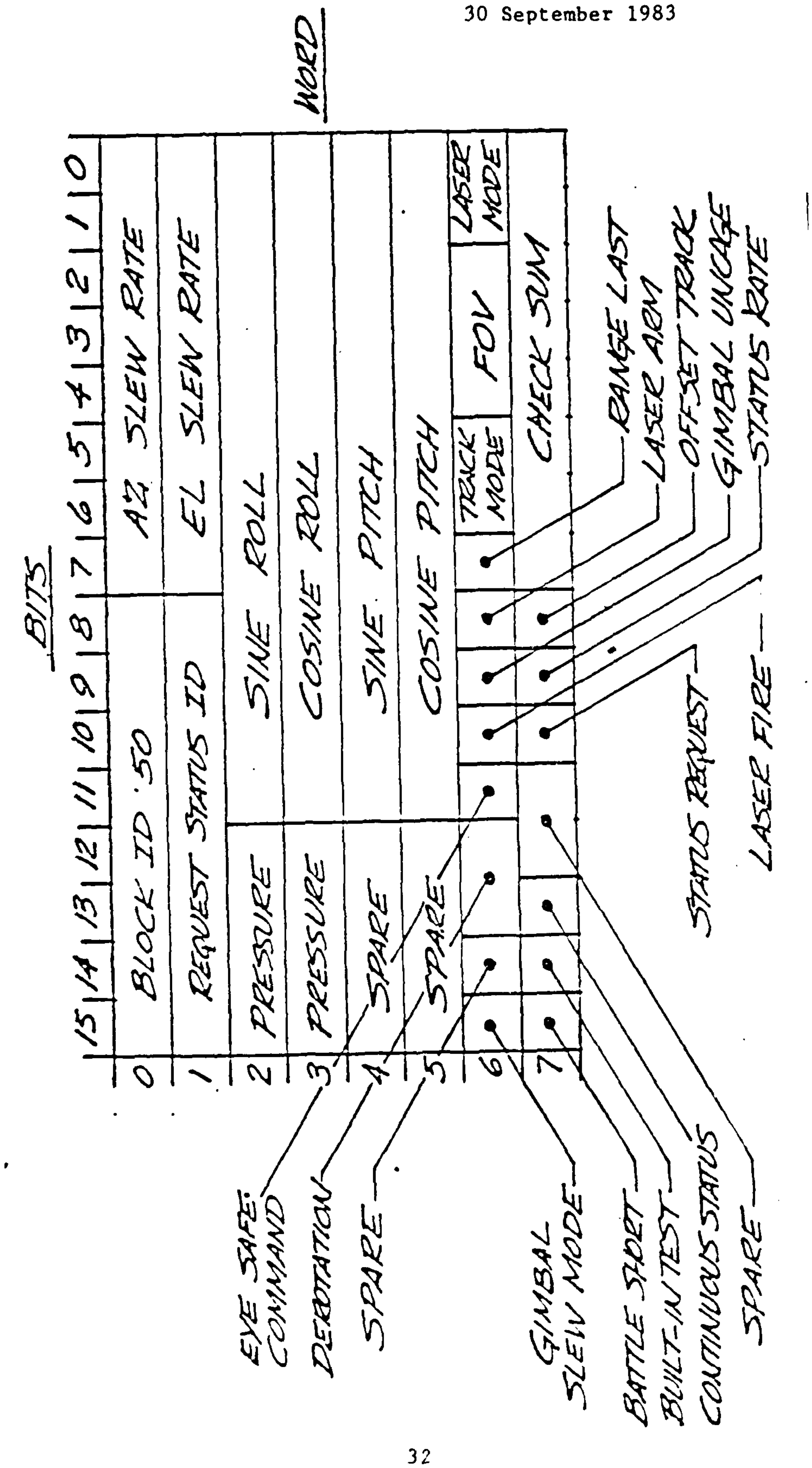


Fig. 15 MPS Command Data Block 50

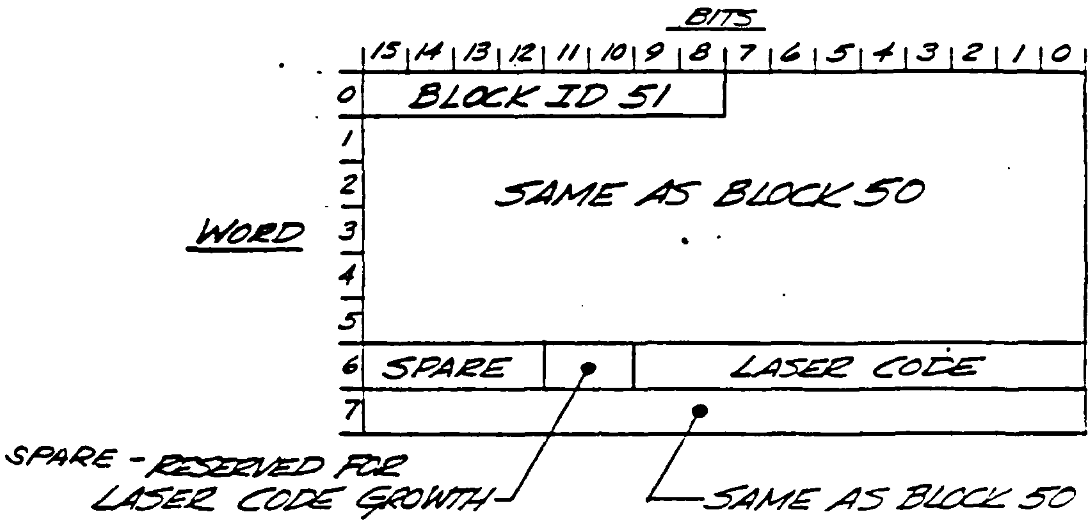


Fig. 16 MPS Command Data Block 51

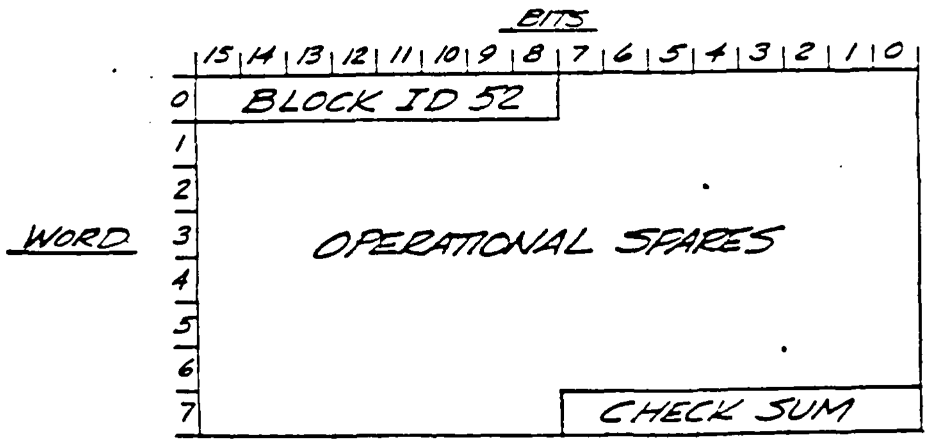


Fig. 17 MPS Command Data Block 52

BITS

WORD	15 14 13 12 11 10 9 8	7 6 5 4 3 2 1 0
0	BLOCK ID 53	
1	RESERVED FOR BIT PATTERN	
2		
3		
4		
5		
6		
7		CHECK SUM

Fig. 18 MPS Command Data Block 53

BITS

WORD	15 14 13 12 11 10 9 8	7 6 5 4 3 2 1 0
0	BLOCK ID 54	WORD COUNT
1	ADDRESS 1	
2	ADDRESS 2	
3	ADDRESS 3	
4	ADDRESS 4	
5	ADDRESS 5	
6	ADDRESS 6	
7	SPARE	CHECK SUM

Fig. 19 MPS Command Data Block 54

Table IV (1 of 3)

COMMAND BLOCK 50

FUNCTION	WORD	BIT	DESCRIPTION
BLOCK ID	0	15-8	FIXED AT 32 HEX
AZ SLEW RATE	0	7-0	STICK X IF GIMBAL SLEW MODE = 0 7F MAX SLEW RIGHT 00 CENTER (ZERO SLEW) 81 MAX SLEW LEFT LSB = 0.1563 DEG/SEC INNER AZ RATE COMMAND IF GIMBAL SLEW MODE = 1, LSB=0.3125 DEG/SEC
EL SLEW RATE	1	7-0	STICK Y IF GIMBAL SLEW MODE = 0 7F MAX SLEW DOWN 00 CENTER (ZERO SLEW) 81 MAX SLEW UP LSB = 0.1563 DEG/SEC ELEVATION RATE COMMAND IF GIMBAL SLEW MODE = 1 ,LSB=0.3125 DEG/SEC
REQUEST STATUS ID	1	15-8	ID 37 HEX TO 3B HEX
PRESSURE ALTITUDE SENSOR	2	15-12	PRESSURE 4 MSB's;UNITS = PSIA BIASED 8.1; BIT 15 IS MSB
SINE ROLL	2	11-0	2's COMPLEMENT FRACTIONAL: BINARY POINT BETWEEN BIT 10 & BIT 11
PRESSURE ALTITUDE SENSOR	3	15-12	PRESSURE 4 LSB's; UNITS = PSIA LSB = 0.02816 PSIA; BIT 12 IS LSB
COSINE ROLL	3	11-0	2's COMPLEMENT FRACTIONAL: BINARY POINT BETWEEN BIT 10 & BIT 11
SINE PITCH	4	11-0	2's COMPLEMENT FRACTIONAL: BINARY POINT BETWEEN BIT 10 & BIT 11
SPARE	4	15-12	
COSINE PITCH	5	11-0	2's COMPLEMENT FRACTIONAL: BINARY POINT BETWEEN BIT 10 & BIT 11
SPARE	5	15-12	
LASER MODE	6	1-0	00 SINGLE PULSE ON 0 TO 1 TRANSITION OF LASER FIRE 01 ONE PULSE/SEC 10 SPARE 11 CODE

Table IV (2 of 3)

FUNCTION	WORD	BIT	DESCRIPTION
FOV	6	4-2	000 1.8 FIELD OF VIEW 001 2.7 010 4.8 011 7.2 100 13.3 101 20 110 VIDEO TEST 111 SPARE
TRACK MODE	6	6-5	00 MANUAL TRACK 01 AUTO SCENE TRACK 10 AUTO TARGET TRACK 11 SPARE
RANGE LAST	6	7	0 MEASURE RANGE TO 1ST TARGET 1 MEASURE RANGE TO LAST TARGET
LASER ARM	6	8	0 NOT ARM 1 ARM
GIMBAL UNCAGE	6	9	0 CAGE 1 NOT CAGE
LASER FIRE	6	10	0 NOT FIRE 1 FIRE
EYE SAFE COMMAND	6	11	0 NORMAL OPERATION 1 EYE SAFE FILTER IN PATH OF LASER BEAM
DEROTATION	6	13-12	00 RELATIVE TO AIR VEHICLE 01 RELATIVE TO LOCAL VERTICAL 10 NO DEROTATION 11 SPARE
SPARE	6	14	
GIMBAL SLEW MODE	6	15	0 STICK X & STICK Y IN AZ & EL SLEW RATE 1 IARC & ERC IN AZ & EL SLEW RATE DETERMINES DATA CONTENT OF BITS 7-0 IN WORDS 0 AND 1

Table IV (3 of 3)

FUNCTION	WORD	BIT	DESCRIPTION
CHECKSUM	7	7-0	THE CHECKSUM BYTE (8 BITS) IS USED TO VERIFY THE VALIDITY OF A MESSAGE. THE CHECKSUM BYTE IS THE VALUE NEEDED TO BE ADDED TO THE REMAINING BYTES TO GIVE A 2's COMPLEMENT SUM OF A NEGATIVE 1. IN OTHER WORDS, THE 2's COMPLEMENT SUM OF BYTES IN ANY MESSAGE INCLUDING THE CHECKSUM BYTE IS EQUAL TO -1 OR FF HEX.
OFFSET TRACK	7	8	0 TRACK CENTERED ON LASER BORESIGHT 1 OFFSET TRACK
STATUS RATE	7	9	0 STATUS AT 15 BLOCKS/SEC 1 STATUS AT 30 BLOCKS/SEC
STATUS REQUEST	7	10	ON 0 TO 1 TRANSITION SUBSTITUTE FOR BLOCK 55 ONE BLOCK IDENTIFIED BY REQUEST STATUS ID, OTHERWISE SEND BLOCK 55 IN CONTINUOUS STATUS MODE. IF COMMAND BLOCK 53 IS SENT RETURN STATUS BLOCK 58. NOTE: SEE BIT TEST DESCRIPTION
SPARE	7	12-11	
CONTINUOUS STATUS	7	13	0 SEND ONE STATUS BLOCK AFTER 0 TO 1 TRANSITION OF STATUS REQUEST 1 SEND STATUS BLOCKS AT 15 or 30 Hz RATE PER REQUEST OF WORD7, BIT9.
BIT TEST	7	14	0 NORMAL OPERATION 1 INITIATES DEDICATED-TIME FOR BUILT-IN-TEST MODE, THE RESULTS ARE REPORTED IN BLOCK 57 AUTOMATICALLY AT THE COMPLETION OF THE TEST.
BATTLE SHORT	7	15	0 NORMAL 1 OVERRIDE

Table V

COMMAND BLOCK 51

FUNCTION	WORD	BIT	DESCRIPTION
BLOCK ID	0	15-8	FIXED AT 33 HEX
LASER CODE	6	9-0	BIT 9 MODULATION IDENTIFIER BIT 8, 7, 6 LEAST SIGNIFICANT CODE SELECT DIGIT BIT 5, 4, 3 MIDDLE CODE SELECT DIGIT BIT 2, 1, 0 MOST SIGNIFICANT CODE SELECT DIGIT
	6	11-10	RESERVE FOR LASER CODE GROWTH
SPARE	6	15-12	
THE REST OF THE BLOCK IS IDENTICAL TO COMMAND BLOCK 50.			

Table VI

COMMAND BLOCK 52

Function	Word	Bit	Description
Block ID	0	15-8	Fixed at 34 Hex
Checksum	7	7-0	Checksum as in Command Block 50
All the rest is spare.			

Table VII

Command Block 53

Function	Word	Bit	Description
Block ID	0	15-8	Fixed at 35 Hex
Checksum	7	7-0	Checksum as in Command Block 50
RESERVED FOR BIT PATTERN			

Table VIII

Command Block 54

FUNCTION	WORD	BIT	DESCRIPTION
BLOCK ID	0	15-8	FIXED AT 36 HEX
WORD COUNT	0	7-0	COUNT OF ADDRESSES TO FOLLOW
ADDRESS 1	1	15-0	ADDRESS OF WORD TO FETCH AND RETURN
ADDRESS 2	2	15-0	ADDRESS OF WORD TO FETCH AND RETURN
ADDRESS 3	3	15-0	ADDRESS OF WORD TO FETCH AND RETURN
ADDRESS 4	4	15-0	ADDRESS OF WORD TO FETCH AND RETURN
ADDRESS 5	5	15-0	ADDRESS OF WORD TO FETCH AND RETURN
ADDRESS 6	6	15-0	ADDRESS OF WORD TO FETCH AND RETURN
SPARE	7	15-8	
CHECKSUM	7	7-0	CHECKSUM SAME AS COMMAND BLOCK 50

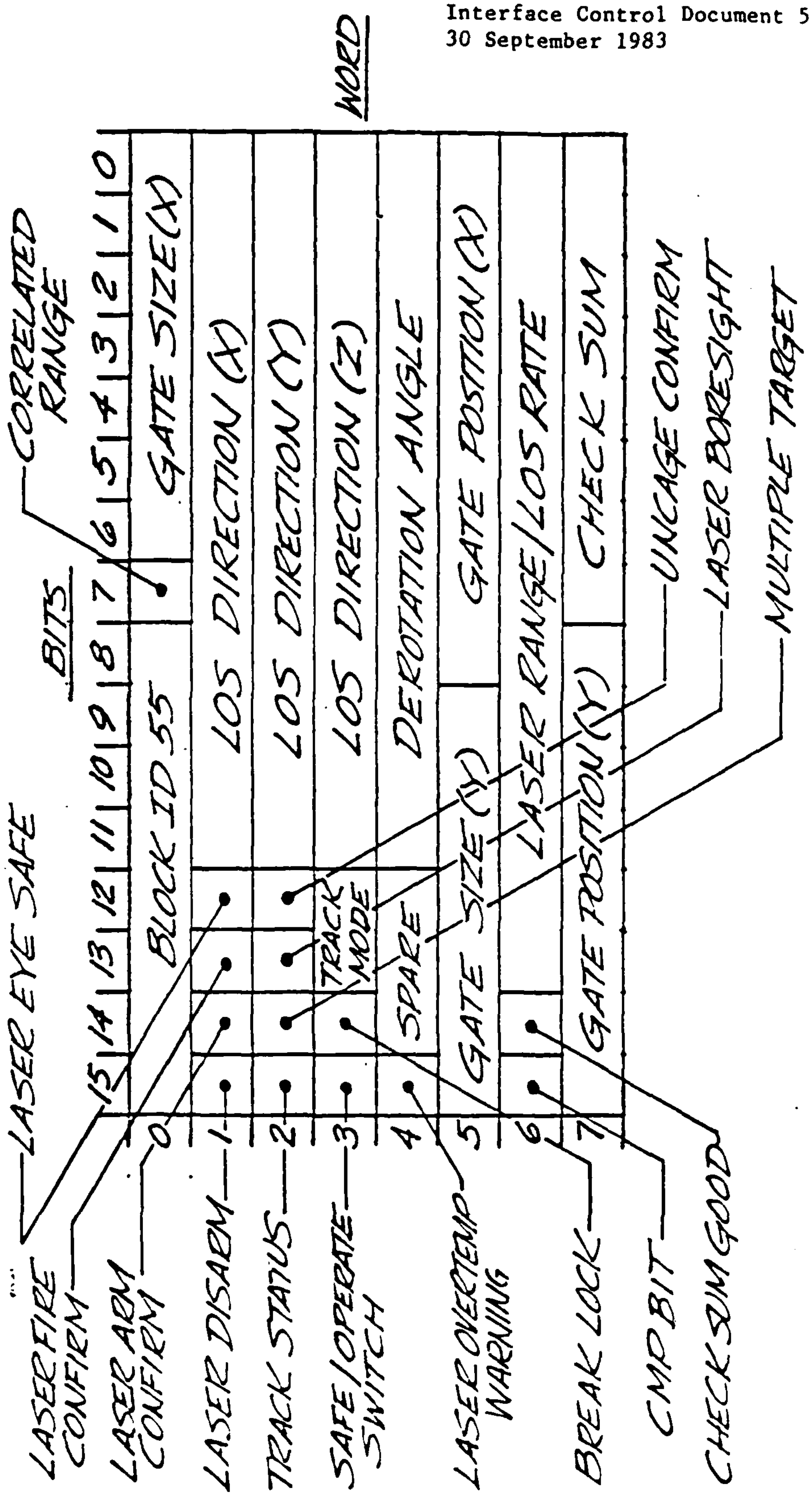


Fig. 20 MPS Status Data Block 55

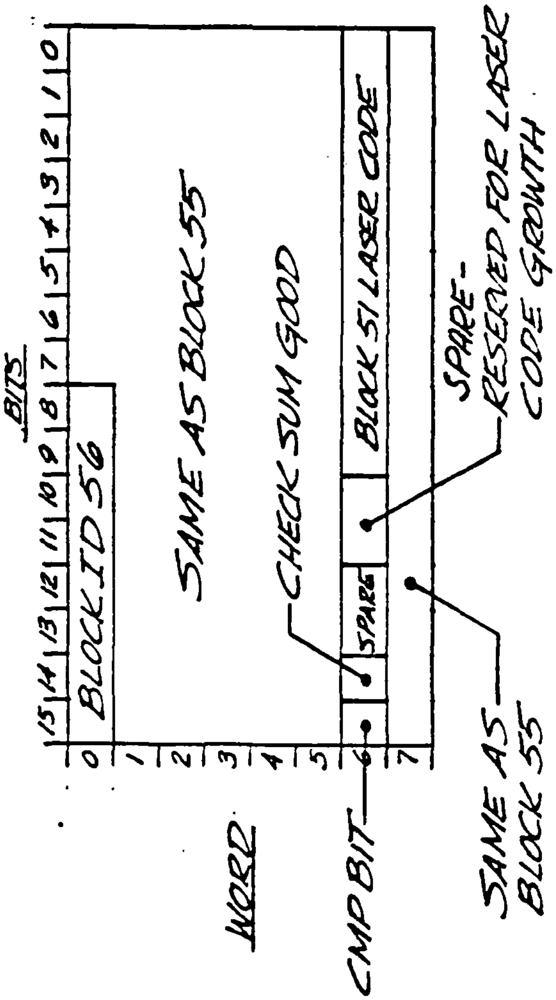


Fig. 21 MPS Status Data Block 56

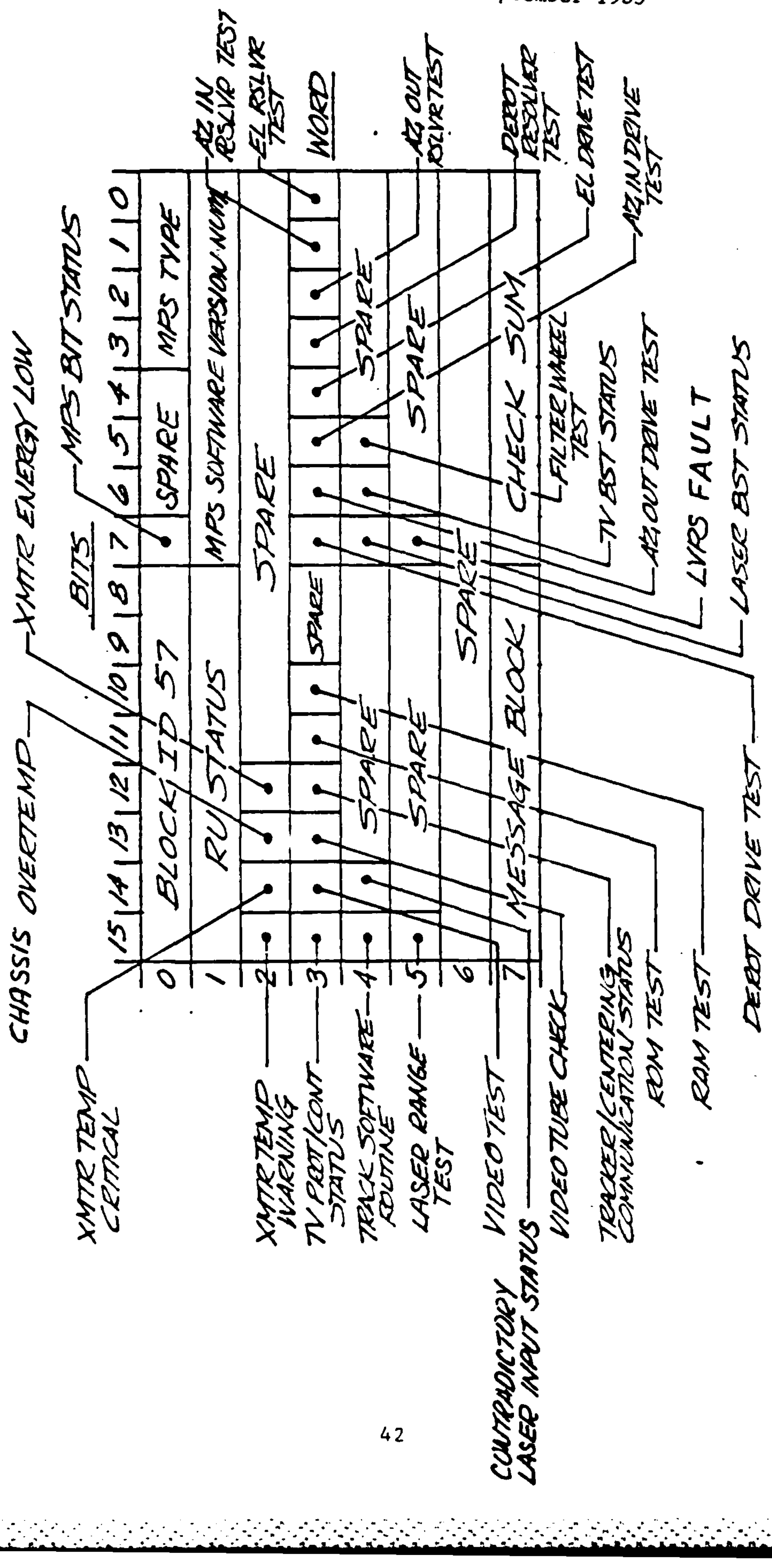


Fig. 22 MPS Status Data Block 57

WORD	BITS 15 14 13 12 11 10 9 8	BITS 7 6 5 4 3 2 1 0
0	BLOCK ID 58	
1	SAME AS LAST RECEIVED COMMAND BLOCK	
2		
3		
4		
5		
6		
7		CHECK SUM

Fig. 23 MPS Status Data Block 58

WORD	BITS 15 14 13 12 11 10 9 8	BITS 7 6 5 4 3 2 1 0
0	BLOCK ID 59	SPARE
1	DATA WORD 1	
2	DATA WORD 2	
3	DATA WORD 3	
4	DATA WORD 4	
5	DATA WORD 5	
6	DATA WORD 6	
7	SPARE	CHECK SUM

Fig. 24 MPS Status Data Block 59

Table IX (1 of 3)

STATUS BLOCK 55

FUNCTION	WORD	BIT	DESCRIPTION
BLOCK ID	0	15-8	FIXED AT 37 HEX
CORRELATED RANGE	0	7	0 ANGLE MEASUREMENTS NOT CORRELATED TO RANGE 1 ANGLE MEASUREMENT CORRELATED TO RANGE
GATE SIZE (X)	0	6-0	WIDTH OF RECTANGULAR SYMBOLOGY IN 6.0200 MHz CLOCK PERIODS
LASER DISARM	1	15	0 QUALIFICATIONS BELOW NOT TRUE 1 LASER DE-ENERGIZED AND EYE-SAFE
LASER ARM CONFIRM	1	14	0 QUALIFICATIONS BELOW NOT TRUE 1 LASER ENERGIZED
LASER FIRE CONFIRM	1	13	0 QUALIFICATIONS BELOW NOT TRUE 1 LASING AT OUTPUT OF LASER AND AT LEAST MINIMUM OUTPUT ENERGY INDEPENDENT OF EYE-SAFE STATUS
LASER EYE-SAFE	1	12	0 QUALIFICATION BELOW NOT TRUE 1 EYE-SAFE FILTER IN PATH OF LASER BEAM
LOS DIRECTION (X)	1	11-0	POSITIVE IS LOGITUDINAL FORWARD †
LOS DIRECTION (Y)	2	11-0	POSITIVE IS LATERAL RIGHT †
LOS DIRECTION (Z)	3	11-0	POSITIVE IS VERTICAL DOWN †

† PROJECTION OF UNIT LINE-OF-SIGHT VECTOR IN AV COORDINATES EXPRESSED AS 2's COMPLEMENT FRACTION WITH BINARY POINT BETWEEN BIT 11 AND BIT 10.

Table IX (2 of 3)

FUNCTION	WORD	BIT	DESCRIPTION
			LOS DIRECTIONS: X = COSINE (AZ) * COSINE (EL) Y = SINE (AZ) * COSINE (EL) Z = -SINE (EL) EL = 0, AZ = 90 POINTING OUT RIGHT WING AZ = 0, POSITIVE EL POSITION IS POINTING UP
TRACK STATUS	2	15	0 NOT AUTO TRACK 1 AUTO TRACKING
LASER MULTIPLE TARGET INDICATOR	2	14	0 SINGLE TARGET 1 MULTIPLE DETECTED
LASER BORESIGHT	2	13	0 LASER BORESIGHT OUT OF TOLERANCE 1 LASER BORESIGHT WITHIN TOLERANCE
UNCAGE CONFIRM	2	12	0 GIMBAL IN CAGED POSITION 1 GIMBAL NOT IN CAGED POSITION
BREAK LOCK	3	14	0 NORMAL TRACK 1 IMPENDING BREAK LOCK
SAFE/OPERATE SWITCH	3	15	0 SAFE/OPERATE SWITCH ON MPS IN OPERATE POSITION 1 SAFE/OPERATE SWITCH ON MPS IN SAFE POSITION
TRACK MODE	3	13-12	00 NOT AUTO TRACK 01 AUTO SCENE TRACK (CORRELATION TRACKING ONLY) 10 AUTO TARGET TRACK(CORRELATION TRACKING WITH CENTROID AIDING) 11 SPARE
LASER OVERTEMP	4	15	0 QUALIFICATION BELOW NOT TRUE 1 LASER OVERTEMP WARNING (TEMP A)
SPARE	4	14-12	
DEROTATION ANGLE	4	11-0	000 = 0° LSB = 360/4096 FFF = 359.99°
GATE SIZE (Y)	5	15-9	HEIGHT OF RECTANGULAR SYMBOLOGY IN TV FIELD LINES

Table IX (3 of 3)

FUNCTION	WORD	BIT	DESCRIPTION
GATE POSITION (X)	5	8-0	LEFT SIDE OF RECTANGULAR SYMBOLOGY IN 6.0200 MHz CLOCK PERIODS FROM POINT "R" (FIG 26) 000 MAXIMUM LEFT ON T.V. DISPLAY 1FF MAXIMUM RIGHT. ØB2 CENTERED SMALLEST GATE*
CMP BIT	6	15	CONTINUOUS MONITORED PARAMETER FOR BUILT IN TEST+ 0 ALL TESTS PASS 1 FAILURE
CHECKSUM GOOD	6	14	1 = GOOD, 0 = BAD PREVIOUS TRANSMISSION FCEP TO MPS
LASER RANGE/ LOS RATE	6	13-0	LSB 5 METERS SENT WHEN LASER IS FIRING
		11-0	LOS RATE = $\left(\omega_x^2 + \omega_y^2\right)^{1/2}$ SENT WHEN LASER IS NOT FIRING LSB = 20°/SEC/2047
GATE POSITION (Y)	7	15-8	TOP OF RECTANGULAR SYMBOLOGY IN T.V. FIELD LINES FROM VERTICAL COUNTER ENABLE (FIG 26) 00 MAXIMUM UP ON T.V. DISPLAY FF MAXIMUM DOWN.7C CENTERED SMALLEST GATE*
CHECKSUM	7	7-0	CHECKSUM AS COMMAND BLOCK 50

* CONCENTRIC TO LØS DEFINED IN FIG. 33

+ DOES NOT INCLUDE THE CONTRADICTORY LASER TEST

Table X

STATUS BLOCK 56

FUNCTION	WORD	BIT	DESCRIPTION
BLOCK ID	0	15-8	FIXED AT 38 HEX
CMP BIT	6	15	1 = FAILURE 0 = ALL TEST PASS *
CHECK SUM GOOD	6	14	1 = GOOD 0 = BAD
SPARE	6	13-12	
SPARE	6	11-10	RESERVED FOR LASER CODE GROWTH
LASER CODE	6	9-0	SEE COMAND BLOCK 51

THE REST OF BLOCK IS IDENTICAL TO STATUS DATA
BLOCK 55

* DOES NOT INCLUDE
CONTRADICTORY LASER
TEST

Table XI (1 of 3)

Status Block 57

FUNCTION	WORD	BIT	DESCRIPTION
BLOCK ID	0	15-8	FIXED AT 39 HEX
MPS DEDICATED-TIME BIT STATUS	0	7	0 GO 1 NO GO
SPARE	0	6-4	
MPS TYPE	0	3-0	0 = WESTINGHOUSE
		(BYTE 2)	15 14 13 12 11 10 9 8
RU STATUS	1	15-8	0 0 0 0 0 0 0 0 GO
			X X X X X X X 1 LASER XMTR FAULT
			X X X X X X 1 X TV CAMERA FAULT
			X X X X X 1 X X RSLV/DIGITAL FAULT
			X X X X 1 X X X GIMBAL ASSY FAULT
			X X X 1 X X X X OPTICS FAULT
			X X 1 X X X X X LASER RNG. RCVR. FAULT
			X 1 X X X X X X LVPS FAULT
			1 X X X X X X X CHASSIS FAULT
MPS SOFTWARE VERSION NUMBER	1	7-0	8 BIT VENDOR'S VERSION NUMBER
XMTR TEMP. WARM	2	15	0 WARNING TEMP. THRESHOLD NOT EXCEEDED (TEMP. A) 1 WARNING TEMP. THRESHOLD EXCEEDED

Table XI (2 of 3)

FUNCTION	WORD	BIT	DESCRIPTION
XMTR TEMP. CRIT	2	14	0 CRITICAL TEMP. THRESHOLD NOT EXCEEDED (TEMP. B) 1 CRITICAL TEMP. THRESHOLD EXCEEDED
CHASSIS OVERTEMP.	2	13	0 TEMP. THRESHOLD NOT EXCEEDED 1 TEMP. THRESHOLD EXCEEDED
XMTR ENGY LOW	2	12	0 OUTPUT LASER ENERGY ABOVE THRESHOLD 1 OUTPUT LASER ENERGY BELOW THRESHOLD
SPARE	2	11-0	
TV PROT/CONT STATUS	3	15	0 GO 1 NO GO
VIDEO TEST	3	14	0 PASS 1 FAIL
VIDEO TUBE CHECK	3	13	0 BORESIGHT LED DETECTED 2 OF 4 1 BORESIGHT LED NOT DETECTED 2 of 4
TRACKER/CENTERING COMMUNICATION STATUS	3	12	0 TRACKER/CENTERING COMMUNICATION PASS 1 TRACKER/CENTERING COMMUNICATION FAIL
ROM TEST	3	11	0 ROM PASS 1 ROM FAILURE
RAM TEST	3	10	0 RAM PASS 1 RAM FAILURE
SPARE	3	9-8	
DEROT DRIVE TEST	3	7	0 DRIVE VOLTAGE IN TOLERANCE 1 DRIVE VOLTAGE OUT OF TOLERANCE
AZ OUT DRIVE TEST	3	6	0 DRIVE VOLTAGE IN TOLERANCE 1 DRIVE VOLTAGE OUT OF TOLERANCE
AZ IN DRIVE TEST	3	5	0 DRIVE VOLTAGE IN TOLERANCE 1 DRIVE VOLTAGE OUT OF TOLERANCE

Table XI (3 of 3)

FUNCTION	WORD	BIT	DESCRIPTION
EL DRIVE TEST	3	4	0 DRIVE VOLTAGE IN TOLERANCE 1 DRIVE VOLTAGE OUT OF TOLERANCE
DEROT RESOLVER TEST	3	3	0 POSITION DATA IN TOLERANCE 1 POSITION DATA OUT OF TOLERANCE
AZ OUT RESOLVER TEST	3	2	0 POSITION DATA IN TOLERANCE 1 POSITION DATA OUT OF TOLERANCE
AZ IN RESOLVER TEST	3	1	0 POSITION DATA IN TOLERANCE 1 POSITION DATA OUT OF TOLERANCE
EL RESOLVER TEST	3	0	0 POSITION DATA IN TOLERANCE 1 POSITION DATA OUT OF TOLERANCE
TRACK SOFTWARE ROUTINE	4	15	0 COMPLETED 1 NOT COMPLETED
CONTRADICTORY LASER INPUT STATUS	4	14	0 NON CONTRADICTORY 1 CONTRADICTORY
SPARE	4	13-8	
LASER BST STATUS	4	7	0 LASER BORESIGHT CONFIRMED 1 LASER BORESIGHT NOT CONFIRMED
TV BST STATUS	4	6	0 BORESIGHT ACHIEVED 1 BORESIGHT NOT ACHIEVED
FILTER WHEEL TEST	4	5	0 END OF TRAVEL CONFIRM 1 END OF TRAVEL NOT CONFIRMED
SPARE	4	4-0	
LASER RANGE TEST	5	15	0 PASS 1 FAIL
SPARE	5	14-8	
LOW VOLTAGE FAULT POWER SUPPLY	5	7	0 PASS 1 FAIL
SPARE	5	6-0	
SPARE	6	15-0	
MESSAGE BLOCK	7	15-8	
CHECKSUM	7	7-0	CHECKSUM SAME AS COMMAND BLOCK 50

Table XII

STATUS BLOCK 59

FUNCTION	WORD	BIT	DESCRIPTION
BLOCK ID	0	15-8	FIXED AT 3B HEX
SPARE	0	7-0	
DATA WORD 1	1	15-0	16 BIT WORD REQUESTED IN WORD 1 OF COMMAND BLOCK 54
DATA WORD 2	2	15-0	16 BIT WORD REQUESTED IN WORD 2 OF COMMAND BLOCK 54
DATA WORD 3	3	15-0	16 BIT WORD REQUESTED IN WORD 3 OF COMMAND BLOCK 54
DATA WORD 4	4	15-0	16 BIT WORD REQUESTED IN WORD 4 OF COMMAND BLOCK 54
DATA WORD 5	5	15-0	16 BIT WORD REQUESTED IN WORD 5 OF COMMAND BLOCK 54
DATA WORD 6	6	15-0	16 BIT WORD REQUESTED IN WORD 6 OF COMMAND BLOCK 54
SPARE	7	15-8	
CHECKSUM	7	7-0	CHECKSUM SAME AS COMMAND BLOCK 50

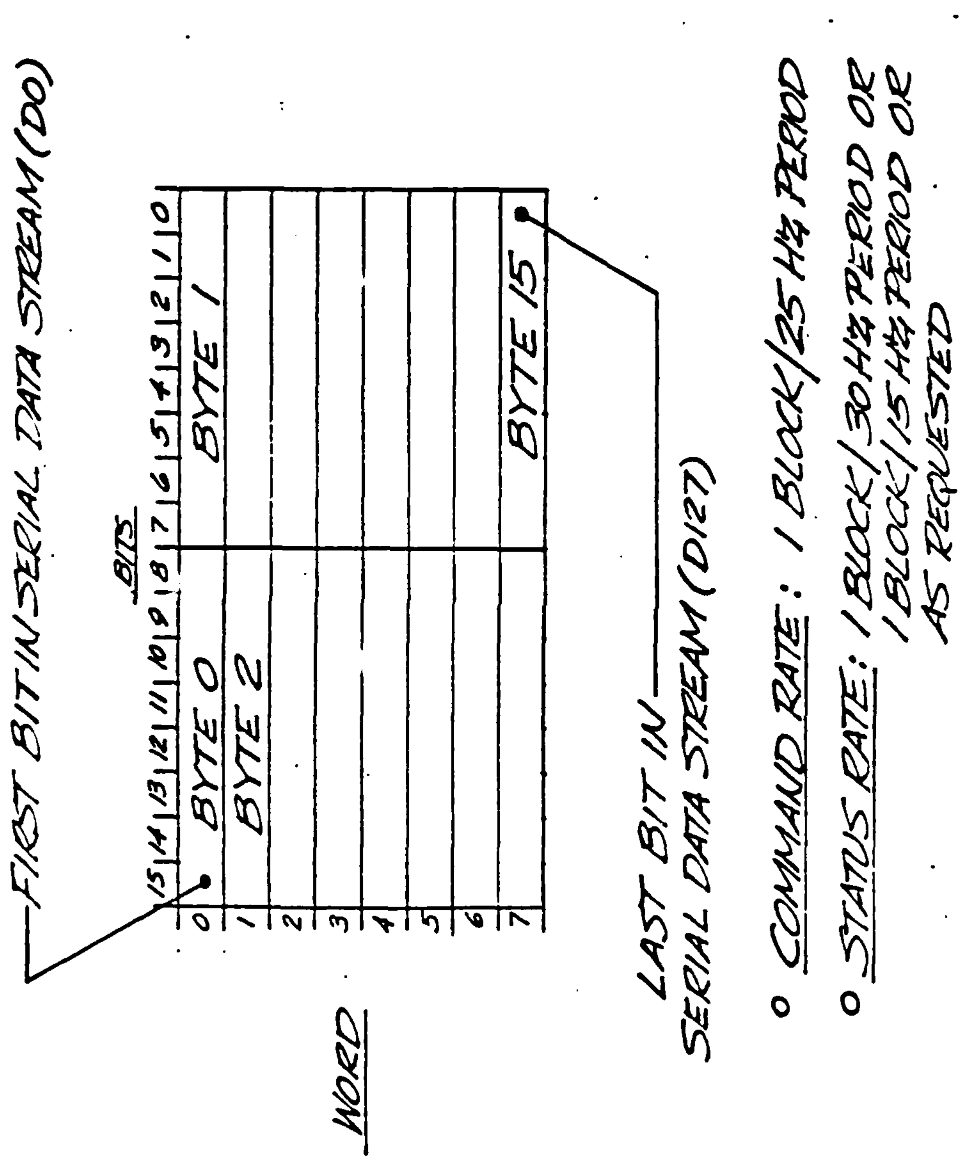
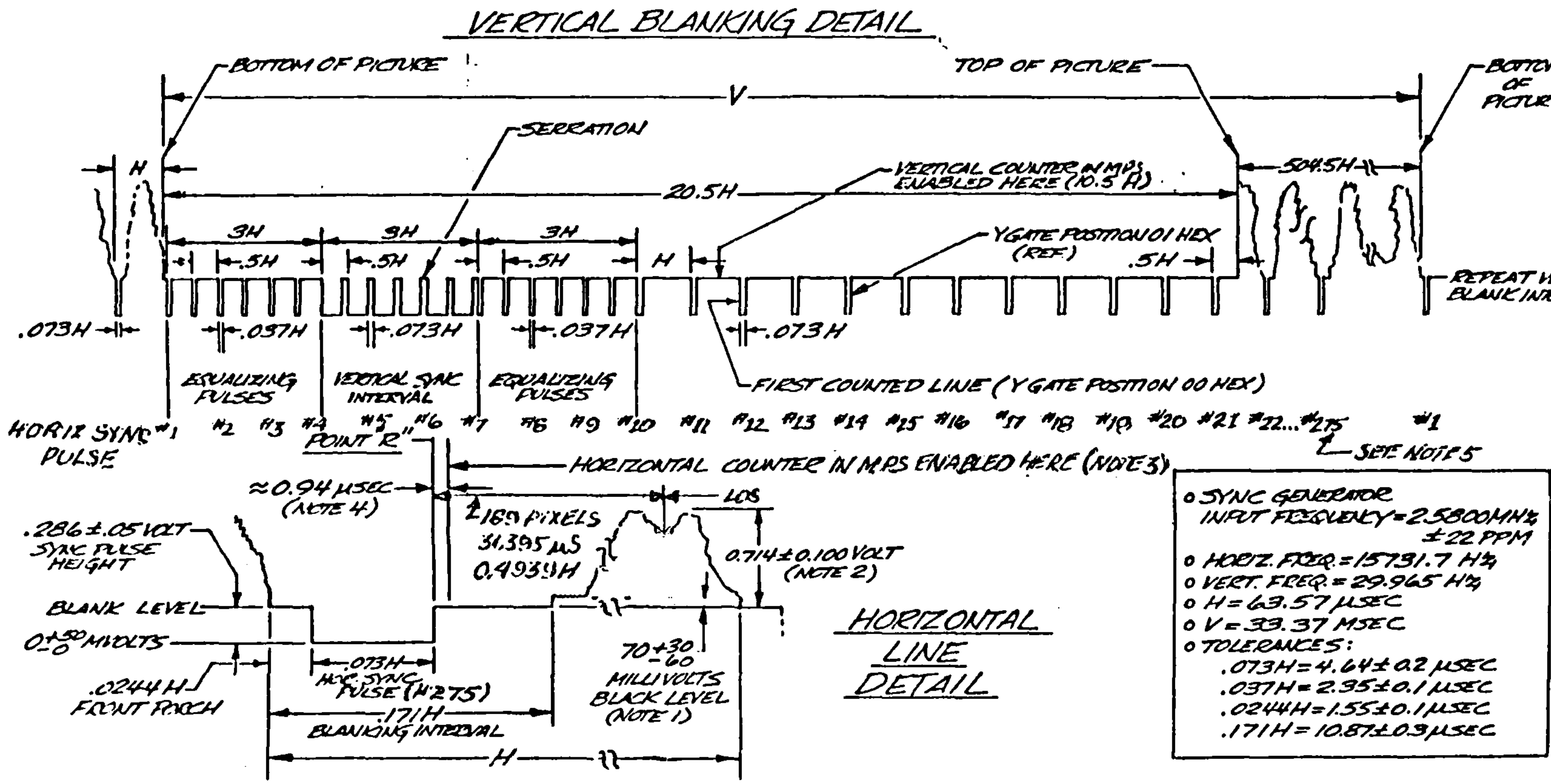


Fig. 25 MPS Data Transfer Sequence



NOTES:

1. SOME NARROW BLACK SPIKES MAY GO TO THE BLANK LEVEL WHERE THEY WILL BE CLIPPED.
2. THE PEAK WHITE FROM THE MPS IS CLIPPED AT 1.15 VOLT MAX.
3. COUNTS NEXT OCCURRENCE OF 6.020 MHz CLOCK PHASED TO NEAREST 1/6 PERIOD AT POINT "R".
4. 34 COUNTS AT 36.120 MHz IS APPROX 0.94 μSEC.
5. LINE 275 PASSES THROUGH LOS; IN SMALLEST GATE, LINE 260 IS TOPMOST LINE IN CENTERED TRACK GATE.

Fig. 26 MPS Video Format

4.4 Software Interface. The FCEP provides the computer functions for the guidance and control of the air vehicle, including the control of the ADT and the mission payload (CIDS 5780941). In addition, FCEP software controls and monitors the rate of discrete input/outputs between the payload and the FCEP and controls the precise time interval for the transfer of serial digital data between the playload and the FCEP.

4.5 Operations Interfaces

4.5.1 Data Link. The modular integrated communications and navigation system (MICNS) data link is a jam-resistant system comprised of the air data terminal (ADT) in the air vehicle and a ground data terminal (GDT). The ADT consists of a pair of transmitting servo-drive digital control antennas, two receiving antennas, and associated electronics. The GDT consists of a remote ground terminal (RGT), interfacing equipment in the ground control station (GCS), an initializer on the launcher, and special test equipment in the maintenance shelter. The interfacing equipment in the GCS consists of the GDT master interface unit (MIU) and a video reconstruction unit (VRU) that reconstitutes digitized payload sensor data downliked from the air vehicle (see 4.5.1.2). Data between the RGT and the GCS are transferred via fiber optic cables. The data link interfaces with the RPV system are controlled by ICD 5030380. MICNS uses adaptive signal processing and other techniques for removing wideband interference signals.

4.5.1.1 Data Types. The MICNS equipment is capable of processing the following information, both for command and control of the air vehicle and the GDT and for transfer of mission payload sensed data:

- o Command data - GCS information uplinked to the AV via the MICNS data link
- o Sensor data - Video signal downlinked from the AV to the GCS via the MICNS data link
- o Telemetry data - AV and ADT status information downlinked to the GCS via MICNS data link
- o GDT status - Operational information generated within the GDT and sent to the GCS
- o GDT control - Operational control messages sent to the GDT by the GCS

4.5.1.2 Data Link Operations. The ADT receives and transfers all uplink command data to the air vehicle's flight control electronics package (FCEP). The FCEP provides the computer functions for the guidance and flight control of the air vehicle, including the control of the ADT and the mission payload, and it monitors ADT and AV health and inflight status. The ADT receives AV telemetry data from the FCEP and analog video from the mission payload; these data are multiplexed together and downlinked. The video is transferred directly from the mission payload to the ADT, where the signal is digitized prior to multiplexing it for downlink transmission. Downlinked telemetry from the AV is relayed from the RGT to the GCS without further processing. The GDT interfacing equipment (MIU and VRU), located in the GCS, reconstitutes the digitized payload sensor data to analog video and also provides the composite video timing wave form in accordance with ICD 5030381 prior to transferring the information to the GCS interface unit (Fig. 26) for video display on operator consoles in the GCS.

4.5.2 Ground Control Station (GCS). The GCS is a sheltered, mobile operational/control center for the RPV System and includes a mission planning facility, control and display consoles, a computer, tactical communications

equipment, and data link interfacing equipment that communicates with the remote ground terminal. A functional diagram is shown in Fig. 27 and an interior configuration in Fig. 28.

4.5.2.1 External Interface. Among the RPV system external interfaces in the GCS is a complete communications system. This includes three radios with communications security equipment and one secure wireline, together with an Army Digital Message Device (DMD). The GCS provides direct communication between each RPV Section (Brigade) and Division, command, intelligence, and artillery operations (TACFIRE).

4.5.2.2 Mission Payload Operator Console. The mission payload operator control and display (C&D) console is one of three operator consoles in the GCS (Fig. 31). The physical configuration of the console, its functional block diagram, and the control panel arrangement are shown in Figs. 29, 30, and 31. The console houses the video control, mission mode control, laser control/display, target/line of sight display, and joystick control functions. It also contains provisions for the integration of alternate payload control functions, either by replacing or adding to existing assemblies in the console. All serial I/O data are controlled by the GCS main computer. Joystick commands, as well as analog video to and light pen commands from the console assemblies, are directly transferred to the GCS interface unit, where the information is processed, formatted, and merged with output from the GCS main computer in preparation for uplink transmission via MICNs by the GDT/MIU.

4.5.2.3 Console Capabilities. The following capabilities and console features are relevant to mission payload operations:

a. Video Monitoring and Control. The console has the capability for operator-selectable fields of view (FOVs) from among six settings. Three of these, the 20/7.2/2.7 deg settings, are optically controlled in the daylight MPS. The FOV changer functions as a mechanically compensated zoom by axial translation of a lens group in the daylight MPS. Focus is automatically compensated for by changes in payload compartment temperature and AV altitude. No range correction is

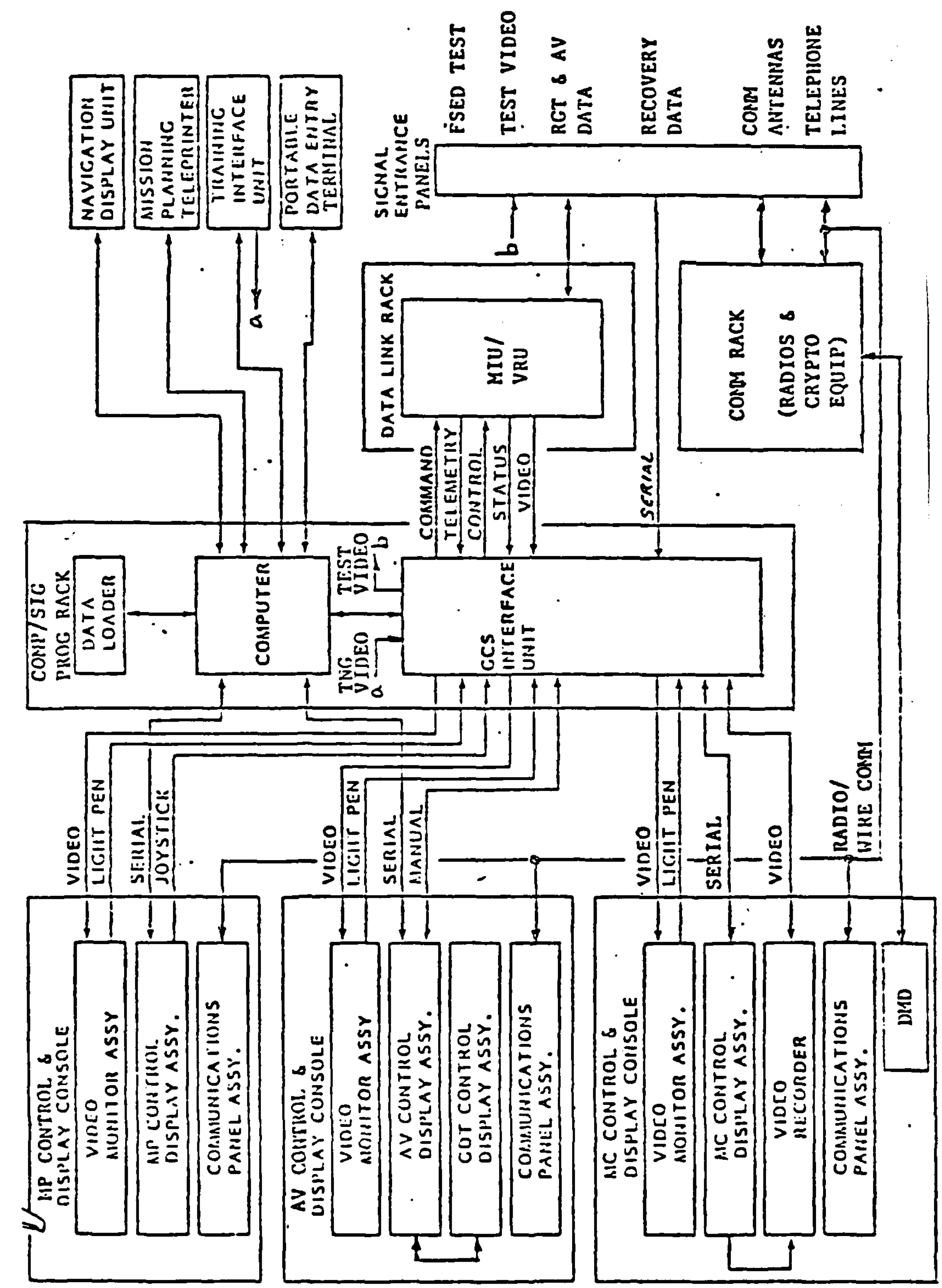


Fig. 27 GCS Functional Diagram

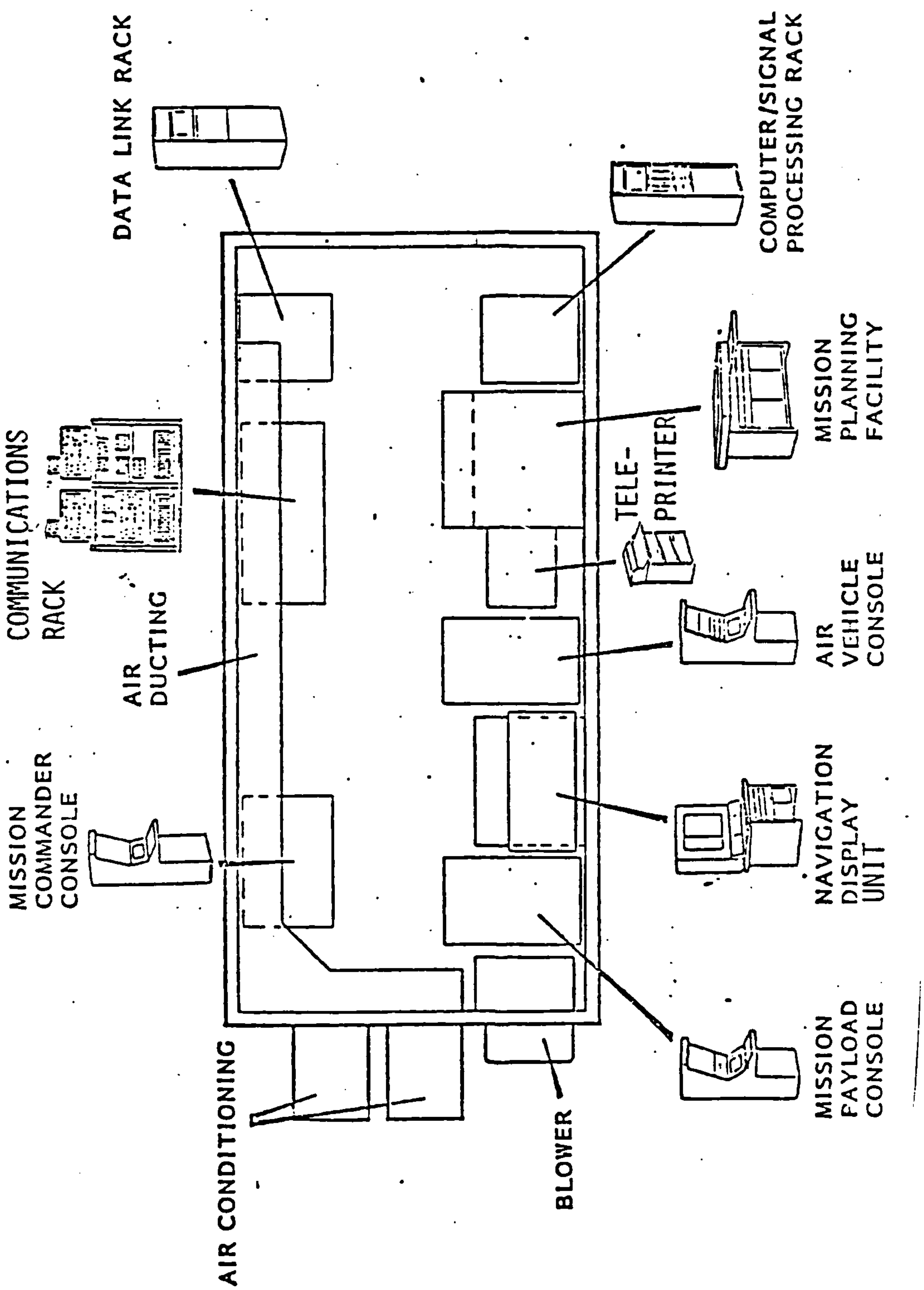


Fig. 28 GCS Interior Layout

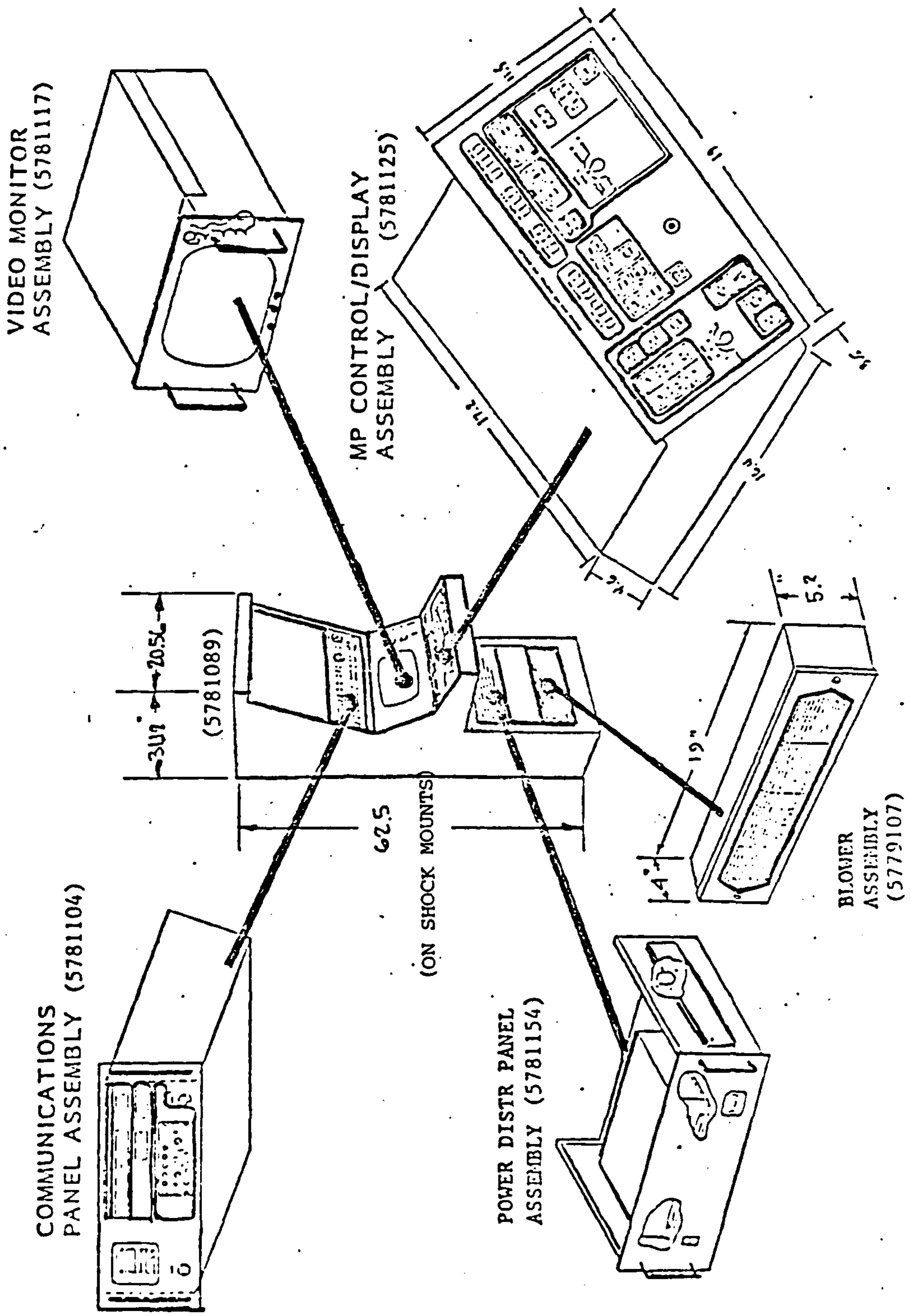


Fig. 29 Mission Payload Operator Control and Display Console

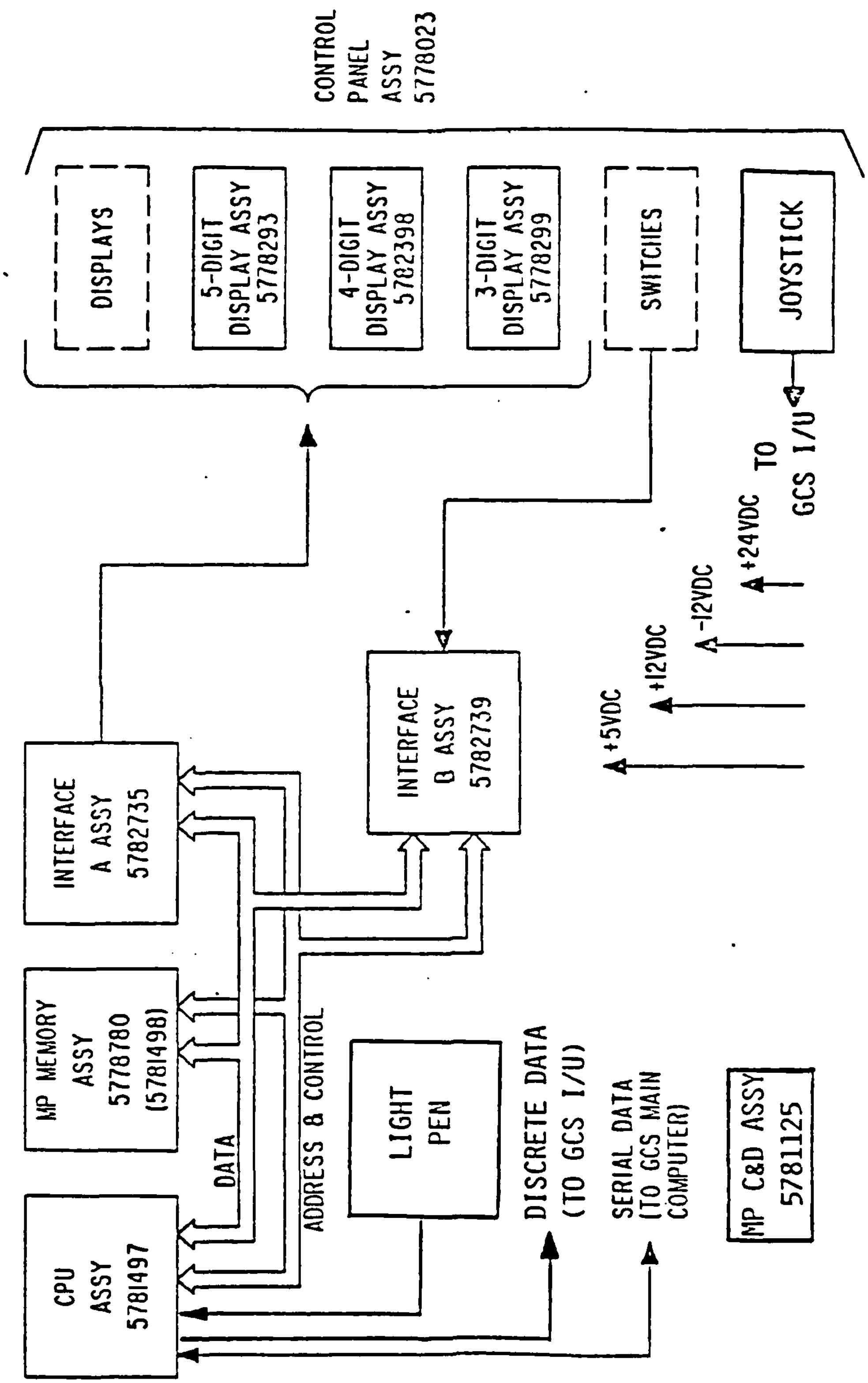
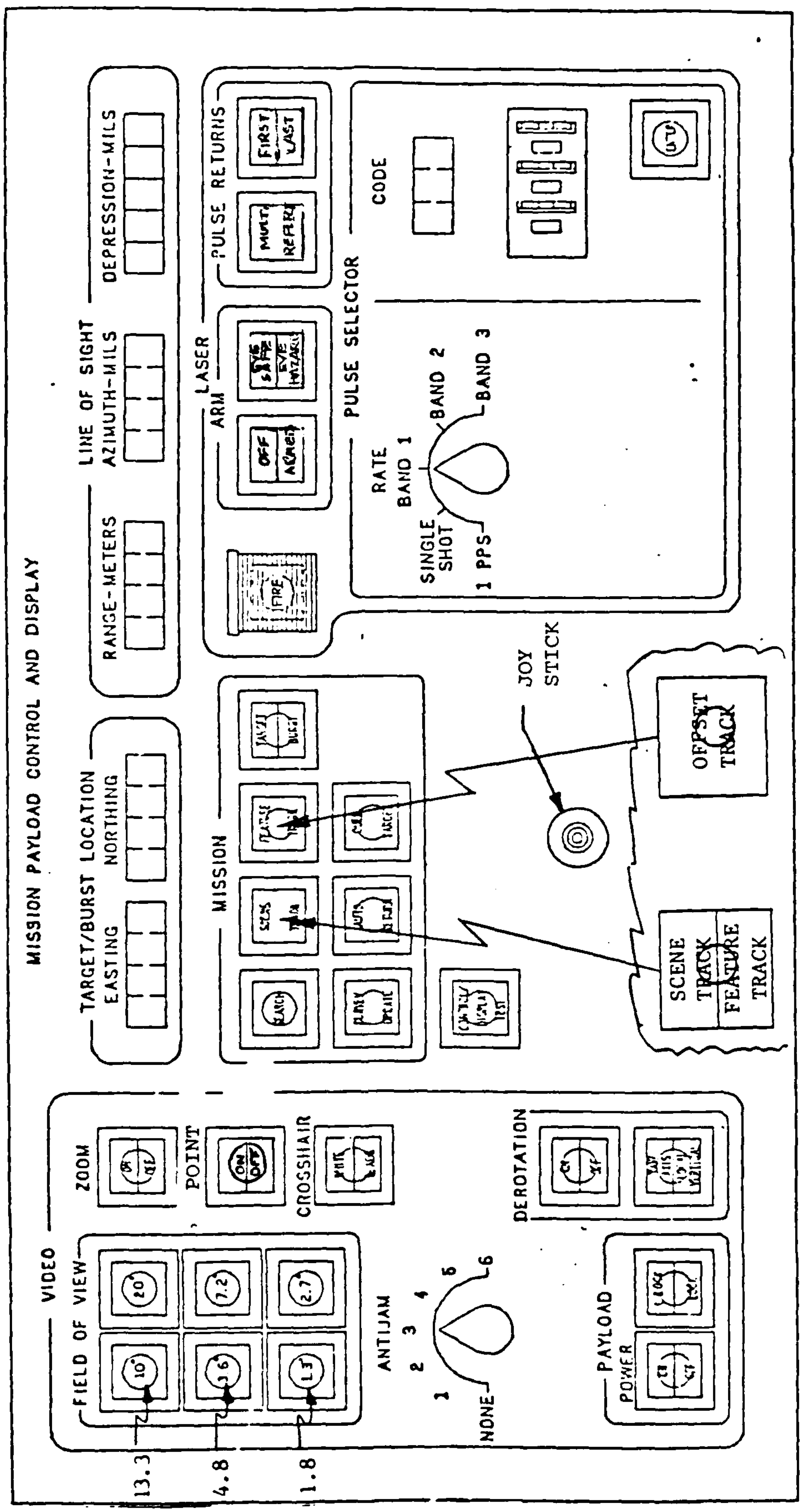


Fig. 30 MP C/D Assembly Block Diagram



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* CHANGES IN PROCESS

Fig. 31 Mission Payload Control/Assembly Display

required. The console has an operator-selectable TV camera image derotation capability which is accomplished in the MPS by a servo-controlled prism in the optical train of the TV camera. Derotation ensures an erect image with respect to the local AV vertical at all lines of sight (LOS), regardless of AV attitude. It maintains automatic focus at all FOVs. The video monitor is equipped with video contrast/brightness controls and an operator-selectable image polarity reversal control. Maximum overall image distortion as viewed on the video monitor does not exceed 6 percent of the vertical height in any direction in the center 50 percent of the FOV. Distortions of up to 9.5 percent are permitted in the remaining FOV. The video monitor is equipped with laser and autotracker aimpoint reticles. Coordinate locations of the reticle center, the aimpoint, and one corner point are provided by the payload.

b. Mission Mode Control. The mission playload is slewable, and the operator has the capability to point the payload through all azimuth angles in the lower AV hemisphere and up to +20 deg in elevation above the horizontal reference frame of the AV. Slew commands are entered through the joystick. An output voltage is generated as pressure is applied to the joystick, and the output is transformed into serial digital commands which are presented to the payload at the payload/FCEP signal interface.

c. Laser Control/Display. Laser firing commands are programmed to provide three operator-selectable designation codes. Tri-service interpulse coding is used. The laser transmitter, employed in the daylight MPS, provides synchronized pulse transmissions for self-contained line-of-sight ranging. When operated in the rangefinding mode, multiple laser reflections are displayed to the operator. Laser pulse returns furnish slant range information along the mission payload boresight axis and provide in-flight confirmation of boresight alignment. Operator-selectable first and last pulse ranging logic is used.

Finally, the console is equipped with protective and interlock devices for safe operation of the laser. Laser powering requires activation of a laser arm command and continuous AV-receipt of the data link signal. The operator has an indication when the laser is firing and is able to turn off the laser at any time by interrupting its power supply. A filter is automatically inserted into the beam path of the laser when power is interrupted, rendering the laser eye-safe.

4.5.3 Mission Planning. All mission planning is performed in the GCS at the mission planning facility using maps, work sheets, and supplied and generated data, including payload operational capabilities. Although normally conducted during preflight/prelaunch operations, it is possible to enter flight planning data for a subsequent mission while a current mission is being flown, without interfering with the current mission. It is also possible to alter a plan during the course of a mission.

4.5.4. Launch and Recovery Effects

4.5.4.1 Launcher Subsystem Interface. The launcher subsystem (LS) is a mobile, truck-mounted, hydraulic pressurized catapult which accelerates (attains 8 g) the AV into the air and has provisions for AV engine starting, automatic prelaunch checkout, and launch.

4.5.4.1.1 Physical Interfaces. The physical interfaces for the MPS relate to clearances. In addition to compliance with the physical interface requirements for payloads specified in Section 4.1, some launcher shuttle and launch pad interface clearances must be maintained. The general arrangement is shown in Fig. 32. Referring to the nomenclature of the figures in Section 4.1, payload protuberance(s) do not extend aft of F.S. 150, outboard of BL ±18, or below WL 84 to maintain LS clearances.

4.5.4.1.2 Functional/Electrical Interface

4.5.4.1.2.1 Signal and Power. Prior to the establishment of the data link, prelaunch signals and power are transmitted to the AV through separate

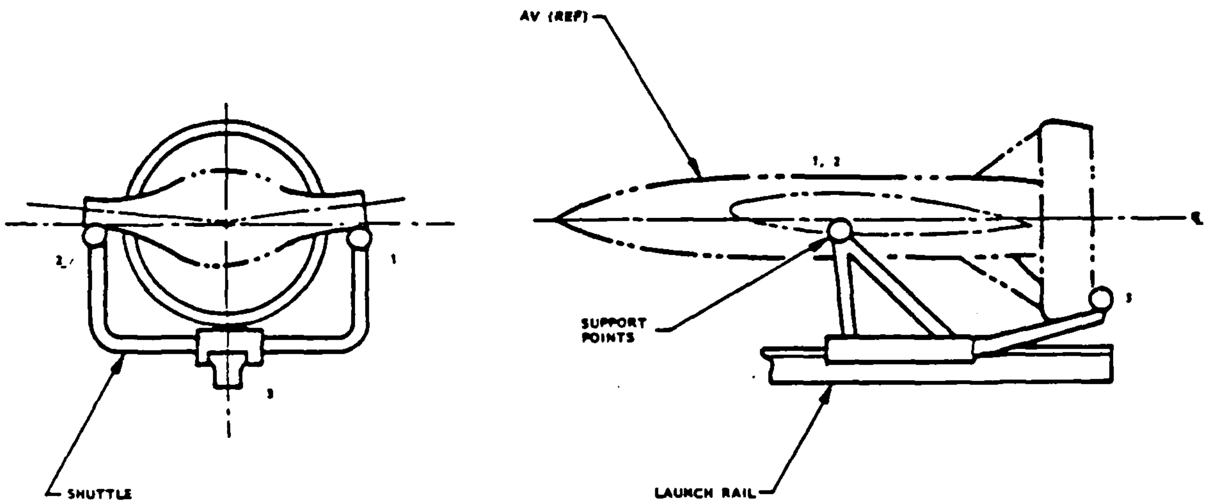

Fig. 32 AV-LS Physical Arrangement

signal and power umbilicals. However, there is no direct access to these external (to the AV) sources by the payload.

4.5.4.1.2.2 Launch Operations/Launcher Functions. Preparation of the AV for launch begins with operations on the air vehicle handler (AVH) vehicle. The AV is removed from its container, fueled, assembled, and inspected on the AVH, and then mated to the launcher (shuttle). Umbilicals and the engine starter are attached to the AV at the appropriate time. The MICNS initializer is manually loaded with the data link code, synchronization, and transmission frequency for subsequent automatic loading into the MICNS ADT. Once the automatic launch sequence (prelaunch system checkout) is initiated, a 9-minute sequence of computer controlled events occurs. This includes the establishment of the data link between the RGT and the AV ADT, the loading of the AV with mission data, and the automatic AV built-in test (BIT), as well as various commands and status data between the GCS, the launcher and the AV. This test includes a command from the FCEP to the MPS to return a payload status (go/no go) signal consistent with FCEP Critical Item Development Specification 5780941. The sequence concludes with the launch command from the GCS, last checks within the AV, and the launch of the AV by the launcher. This sequence is primarily controlled by software with minimal manual (operator) actions. The prelaunch sequence is shown in Fig. 33. The LS contains three separate but interactive control and display consoles. They are the command module, the MICNS initializer, and the launcher control panel. All three panels contain appropriate status and control displays and provisions for manual inputs/commands. None of these panels addresses manual interactions with the payload. If the air vehicle subsystem fails to pass this system prelaunch checkout and launch, it is removed from the launcher and transported to the maintenance shelter for fault isolation to the removeable unit level. This fault isolation involves the use of the air vehicle fault isolator (AVFI). There is no interface between the AVFI and the MPS. All status check commands are received by the MPS from the FCEP, and status is returned to the FCEP by the MPS.

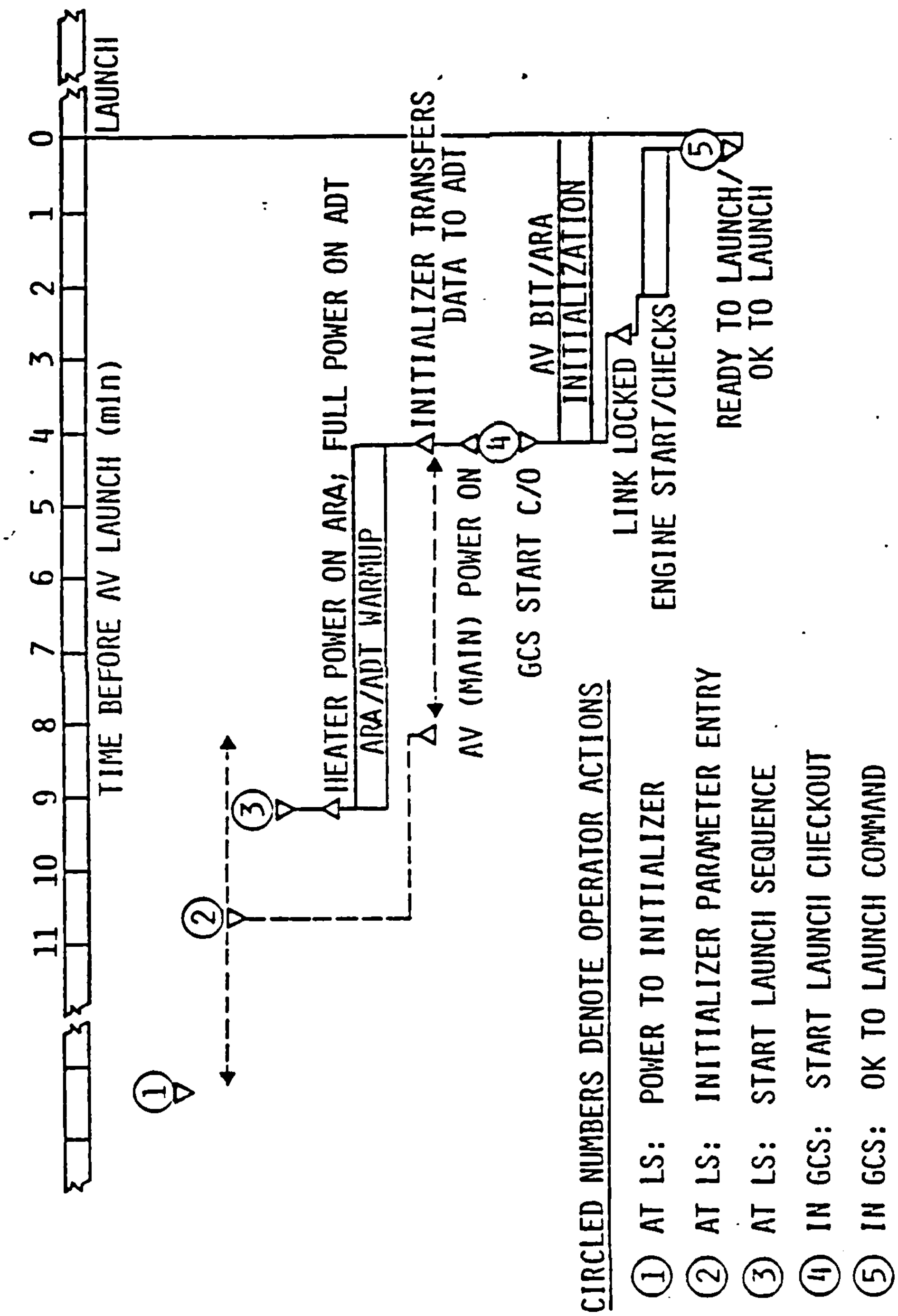

Fig. 33 Prelaunch Functional Sequence

System checkout accomplished while the air vehicle is on the launcher is known as prelaunch checkout. The timelined functional sequence is shown in Fig. 33. Air vehicle maintenance checks conducted in the maintenance shelter are known as preflight testing. During preflight testing of the AV and system prelaunch checkout and operation, there are no provisions for opening access covers to adjust, program, inspect, or initialize the MPS.

The RS contains an adjustable braking system which limits the deceleration forces on the AV. This system is manually adjustable for various AV weights and ambient temperatures.

4.5.4.2 Recovery Subsystem Interface. The recovery subsystem (RS) is a mobile, truck-mounted, erectable structure with a vertical net into which the AV flies and is recovered. As described in Section 4.5.5.1, AV guidance updates are provided by the automatic recovery system.

4.5.4.3 Dynamic Loads. Launch and recovery loads on the AV are as noted on Fig. 10.

4.5.5 Automatic Recovery System

4.5.5.1 Recovery Guidance Aid System

4.5.5.1.1 Physical Description. The recovery guidance aid system consists of a near infrared (NIR) emitting source mounted in the nose of the AV, a pair of sensors (azimuth and elevation) mounted on the RS net support structure, a signal processing/control assembly mounted on the RS truck, controls and displays in the GCS, and supporting AV and GCS software. Recovery is automatic (control by software) including aborts with provisions for manual overrides. This is the principal system for guiding the AV into the recovery subsystem net.

4.5.5.1.2 Functional description. Recovery waypoints, complete with abort provisions, are determined from the RS net location and orientation. These waypoints are used to guide the AV to a known location, altitude, and orientation relative to the RS net. Upon acquisition of the AV NIR source by the NIR sensors, flight control information is provided to the AV guidance system. Provisions exist for recovery aborts if the AV is outside a specified recovery corridor. With an abort signal the AV will proceed over the net, fly a preplanned path to again intercept the recovery waypoints and receive further recovery instructions.

4.5.5.2 Backup recovery with the MPS. An option exists within the RPV system to utilize the MPS to guide the AV into the recovery net. This mode of recovery guidance imposes no additional requirements on the mission payload subsystem. When the RPV system is used in this mode, the MPS is commanded by system software, through the FCEP/MPS interface, to slew the LOS to a waypoint located at the recovery subsystem. Upon visual identification of the recovery subsystem by the mission payload opertor, the system is placed in the "TRACK" mode, and the air vehicle is automatically flown into the recovery net by the A/V flight control system.

4.5.5.3 Emergency flight termination system. The AV contains a flight termination system consisting of a parachute and associated controls. The parachut is carried during the development program of the RPV systems and during Army training, but will not be installed in the tactical system. The parachute recovery system is activated automatically by preplanned software or upon manual command from a GCS operator. Upon deployment, the system will invert the AV to shield the MPS/turret from heavy damage upon ground impact. Descent and impact occur at a rate of approximately 20 ft/s.

5. NOTES

5.1 <u>Abbreviations.</u> The following identifies less common terms and abbreviations contained in this ICD.

ADT	airborne data terminal
ARA	attitude reference assembly
AV	air vehicle
AVH	air vehicle handler
BIT	built-in test
BITE	built-in test equipment
BL	butt line
C&D	control & display
CG	center of gravity
CIDS	critical item development specification
CPCI	computer program configuration item
CPDS	computer program development specification
DMD	digital message device
FCEP	flight control electronics package
FLIR	forward-looking infrared
FLOT	forward line own troops
FMPS	FLIR mission payload subsystem
FOV	field of view
FS	fuselage station
GCS	ground control station
GFE	Government-furnished equipment
ICD	Interface Control Document
IR	infrared
LOS	line of sight
LRU	line replaceable unit
LS	launch subsystem
MICNS	modular integrated communications and navigation system
MIU	master interface unit (part of MICNS in the GCS)
MPS	mission payload subystem

NIR	near infrared
PGSE	Peculiar ground support equipment
PIDS	Prime item development specification
RAM	random access memory
RGT	remote ground terminal
ROM	read only memory
RPV	remotely piloted vehicle
RS	recovery subsystem
VRU	video reconstruction unit
WL	water line

5.2 RPV System Prelaunch Checkout Versus Air Vehicle Preflight Test. In this document, reference is made to both prelaunch checkout and preflight testing as those actions pertain to the MPS. The purpose of this note is to clarify the essential differences between these two tests.

At the core of the difference is the fact that the RPV System Maintenance Concept and Plan identifies the mission payload subsystem as a line replaceable unit (LRU) which is removed/replaced only at the RPV section (unit) level. No corrective maintenance on the MPS is performed at unit or organizational level.

5.2.1 System Prelaunch Checkout. Under normal RPV section operations, the air vehicle, complete with mission payload, will be removed from its shipping container, have the wings assembled, be transported to the launcher, subjected to a visual inspection, fueled, physically mated to the launch shuttle, and be connected to the launcher umbilicals as described in Section 4.5.4.1. At this point in time, the computer controlled automated prelaunch system checkout is initiated. Figure 33 provides a timeline for this prelaunch system checkout. Various LRUs, including specifically the mission payload subsystem, are subjected to go/no-go status checks. No attempt is made to isolate the fault within an LRU, including the MPS. Each LRU, including the MPS, contains within it, Built-in test/Built-in test

equipment (BIT/BITE) consistent with the requirements of the RPV System Specification AV-SS-RPV-L10000A, which provides status information in response to query by the FCEP across the command block of the signal interface.

5.2.2 AV Preflight Test. If any Air Vehicle LRU returns a no-go status, the launch is aborted, the Air Vehicle is removed from the launcher and returned to the Maintenance Shelter. In the maintenance shelter, the air vehicle complete (less wings) is subjected to a preflight test, including but not limited to the use of the Air Vehicle Fault Isolator. The AVFI isolates faults only at the LRU level. In the case of the MPS, the same internal BIT/BITE is used. If the MPS returns a no-go status during this test, it is removed from the Air Vehicle and dispositioned to the appropriate upper echelon maintenance level. Transfer cases, and removal tools, fixtures, etc., are supplied as part of the payload Peculiar Ground Support Equipment (PGSE).

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